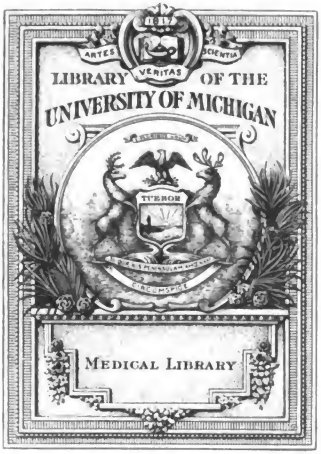
MEDICAL LIBRARY
HA 37 U4 T87

THE DEVELOPMENT OF PUNCH CARD TABULATION IN THE BUREAU OF THE CENSUS 1890-1940

Leon E. Truesdell

U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS

Digitized by Google



THE GIFT OF

Dr. Frank G. Rogers

Digitized by Google

THE DEVELOPMENT OF
PUNCH CARD TABULATION
IN THE BUREAU OF THE CENSUS
1890-1940

WITH OUTLINES OF ACTUAL TABULATION PROGRAMS

by
Leon E. Truesdell

U.S. DEPARTMENT OF COMMERCE
John T. Connor, *Secretary*

BUREAU OF THE CENSUS
A. Ross Eckler, *Director*

WASHINGTON : 1965

For Sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price $1.75 (cloth)

Digitized by Google

Medical Library
HA
37
.U4
787

Digitized by Google

Medical
Gift
Dr. Frank G. Rogers
2-22-66

FOREWORD

The use of electronic computers in the tabulation of the returns in the population census of 1960 represents the latest step in the long history of the development of the U.S. Bureau of the Census. The content of the census has changed from time to time to meet new needs. New procedures for converting the mass of individual returns into usable tabular summaries have been applied as they were developed. The Superintendent of the Census of 1890 could rightly take pride in the gains that were accomplished through the use of the new equipment which initiated the use of punched cards in extensive statistical tabulations, though perhaps he did not realize the outstanding importance of the innovation which first reduced the data on the census schedule to a form which could be classified and counted by purely mechanical devices. Building upon this beginning, there were gradual improvements over the next 50 or 60 years, including both the speeding up of the earlier machines and the devising of additional supplementary equipment, until the daily capacity of the tabulating machines used in 1940 or 1950 was more than 10 times that of their progenitors in 1890. The story of these developments is the subject of this volume.

Dr. Truesdell is in a unique position to relate the history of the period of the gradual development of punch card machinery and the techniques of the attendant procedures. He was intimately connected with four censuses during the period of rapid development, 1910 to 1940, and is also familiar with the methods used in 1950 and 1960. On the basis of this direct personal knowledge and of painstaking research (though sources for the earlier periods are very sketchy) he has worked out the story of the development of this type of machine tabulation in (or for) the Census Bureau, especially as relating to the census of population. In some cases he has had to use the skills of the archaeologist in piecing together fragments of information on procedures used in the early censuses and in supplying reasonable approximations for missing fragments. He has called attention to significant changes, usually representing improvements, between one census and the next, and has given realistic illustrations of the way in which the machine equipment has been adjusted to produce the data required for publication.

This historical study suggests that the search for more effective ways of doing the work of the census may never end. The basic desire is still the same—to finish the required tabulations in the shortest possible

Digitized by Google

time, not only to meet legislative deadlines, but also to give the data to the public while they are still fresh and timely, a matter which becomes increasingly important with the increasing tempo of current developments, both economic and social.

Dr. Truesdell has not only the advantage of long familiarity with the developments and the frustrations which are bound to occur during a period of rapid adjustment to a continually changing technology. He has the additional advantage of being able to review the early history in the light of changes that have taken place in recent decades and those which appear to be in prospect. This later knowledge—perhaps it may be called hindsight—sometimes leads to questions as to why a particular line of development failed to go down what now would seem to have been the best path. It also helps him to fill some of the gaps in the available record.

We have asked Dr. Truesdell to draw on his personal observations and recollections in writing this account. We have also given him a substantial degree of freedom in presenting his personal interpretations and evaluations of various elements in the history of the Census Bureau's tabulation programs. Such evaluations have at a number of points added a new element of interest to an otherwise strictly descriptive or historical account.

Finally, it may be noted that this volume is almost the only convenient source of information on the methods of tabulation used in the Census Office prior to 1890 or on the full circumstances leading up to the invention of the first punch card tabulating system; and it is also the most comprehensive source for information on the early stages of the development of mechanical tabulation. The period covering the development of machine tabulation has been the most important and expansive period in the history of the Census Bureau. At the same time there has been a significant growth in the capacity of statistical equipment available through commercial channels. This has had an important impact on statistical work in general and on current business practices, and has provided a base for one of the Nation's most rapidly expanding industries.

A. Ross Eckler
Director

Digitized by Google

PREFACE

The central purpose of this book is to tell the story of the development of the mechanical devices which made possible the effective use of punched cards for statistical tabulation. Preliminary to this, and serving in some fashion as a background, there is an account of the tally system employed in compiling the returns of the population censuses from 1850 to 1880. This is presented in considerable detail, since little or no specific information about this early method of tabulation is available elsewhere. The 1890 punch card procedures are likewise accorded a generous amount of space, as representing the first large-scale use of mechanical equipment for statistical tabulation.

And running along with the descriptions of the rather slowly improving mechanical equipment, there are specific outlines of the punch cards used and of the "counts" which made up the early tabulation programs. These may not be as readily appreciated as the pictures of the machines, but they do represent specific applications and show an increasing skill in the utilization of the possibilities of the punch card which is quite as significant as the improvements in the machines themselves. Apart from their service as explicit illustrations of the manner in which the new machines were adapted to meet increasing current needs, these outlines provide in themselves a compact record of the evolution of tabulation procedures from 1880 to 1940.

The discussion is for the most part limited to the work of the population census, with an exception for the elaborate equipment provided for the 1900 census of agriculture; and the more recent periods are treated in more summary fashion, with stress only on those features which represented progress or change.

In the matter of personalities there are pages on Herman Hollerith and Dr. John Shaw Billings, the two men who in some fashion must share the credit for the machines on which the 1890 census of population was tabulated, often referred to as the Hollerith system.

The principal sources of data are indicated in footnotes. Most of the specially collected material has been arranged in order and deposited in the Library of the Bureau of the Census. There seems to be hardly enough other pertinent material to justify the publication of a bibliography.

For any reader who is interested primarily in the mechanical equipment, without regard for its adaptation to the census material, the Table of Contents will indicate those sections of the book in which this material is presented.

LEON E. TRUESDELL

Digitized by Google

CONTENTS

Page

Chapter I. CENSUS PROCEDURES PRIOR TO 1890

Early censuses; family returns 1
Individual returns, from 1850; the tally system 1
The 1880 tabulation program 4
The first tally—Sex, color, and nativity 4
The first tally sheet 4
Instructions for tally No. 1 5
Counting the tallies 7
The second tally—Single years of age 8
Instructions for tally No. 2 10
Counting and consolidation 11
Instructions for consolidation sheet 12
The remaining tallies, in brief 13
Tally No. 3—State or county of birth 13
Tally No. 4—Place of birth of parents 14
Tally No. 5—Gainful workers by occupation, sex, and age (3 groups), and by country of birth 15
Tally No. 6—Illiteracy 16
The Seaton device 17
The Seaton device used for tallying 19
Instructions for first tally on Seaton device 21
Comment 22
An early evaluation 22
A further example 23
Seaton device used for consolidation 24
Cards and chips 24

Chapter II. THE TWO MEN WHO ORIGINATED THE PUNCH CARD SYSTEM

Herman Hollerith (1860–1929) 26
Dr. John Shaw Billings (1838–1913) 28
Relations between Mr. Hollerith and Dr. Billings 30

Chapter III. THE HOLLERITH TABULATING SYSTEM

The basic principle 35
Hollerith's first tabulating machine 35
The machine proposed for the 1890 census 38
The early cards 38
The 1889 test 40
The problem of geographic consolidation 43
Details of the 1890 system 43
The keyboard (pantograph) punch 43
The gang punch 44
The punching operation 45

Digitized by Google

The tabulating machine in detail 47
Wiring the tabulating machine 51
The sorting box 51
Operation of the tabulating machine 52
Relays 53
Controls 55
Production records 55

Chapter IV. THE 1890 CENSUS OF POPULATION

The 1890 schedule 57
Punching the 1890 card 57
Advance editing 60
The initial count of population and families 61
The 1890 machine counts—general pattern 62
Tabulation areas 63
First count—Color-nativity by age groups 64
Areas, sort, and controls 64
Counters 64
Checking against initial count 65
Use of fields on the card 65
Wiring for the first count 66
Detail of the relays comprising the age block 67
Entries on result slip 68
Sorting box 69
Publication from first count 69
Second count—Conjugal condition 69
Machine A—Conjugal condition by color-nativity and age 70
Counters 70
Machine B—Conjugal condition by country of birth of mother 71
Counters 71
Sorting box 72
Publication from second count 72
Third count—State or country of birth 73
Areas, sort, etc 73
Machine A—State of birth 74
Machine B—Country of birth 74
Machine C—For adult alien males 74
Sorting box 74
Publication 75
Fourth count—Single years of age, illiteracy, school attendance, etc 75
Sort 75
Machine setup 76
New fields on the card 76
Sorting box 77
Publication 77
Fifth count—Parentage in detail 78
Areas, sort, etc 78
Publication 79
Sixth count—Occupations by sex, color-nativity, etc 79
Areas, sort, etc 80
Machine setup 80
Card fields 80

Digitized by Google

Seventh count—Occupations of the foreign born by country of birth 80
Areas, sort, etc 81
Machine setup 81
Characteristics of home proprietors 81
Supplemental tabulations planned for 1890 data 82

Chapter V. THE 1900 CENSUSES OF POPULATION AND AGRICULTURE

Machinery used in the census of 1900 84
The Hollerith automatic tabulating machine 84
The Hollerith integrating tabulator 84
The electric sorting machine 86
The gang punch for agriculture 88
The key punch used for agriculture 88
Summary of machine equipment 89
The 1900 census of population 89
The schedule 90
Identification of card with schedule 91
The 1900 population card 91
Punching the card 92
Changes in card between 1890 and 1900 93
The verification run 94
Machine tabulation, population, 1900 97
Count B—School, militia, and voting age, etc 97
Count D—State or territory of birth 98
Count E—Country of birth 99
Count H—Years in the United States 100
Count K—Birthplace of parents 101
Count L—Age detail, conjugal condition, etc 101
The occupation count 102
The 1900 census of agriculture 103
The schedule 104
The 1900 farm card 104
Tabulating machine for the farm card 108
The 1900 crop card 110
Tabulating machine for crop cards 113
Evaluation of program 114
The family card, 1900 115
Proposed tabulation of children ever born 116

Chapter VI. THE CENSUS MACHINE SHOP AND THE 1910 CENSUS

Developments in the Census office, 1900–1910 117
Machinery used, 1902–1905 117
The Census Machine Shop 119
The semiautomatic tabulating machine 121
The printing counters, 1906–7 121
Totalizing counters 122
The Census automatic tabulator, 1907–8 122
Compact result slip for the tabulating machine 123
Further developments suggested 124
The Powers punch 124
Sorting machines 127
No punched cards for the 1910 census of agriculture 127
Hollerith offer of machines for 1910 127

Digitized by Google

The Thirteenth Census, 1910 128
Detail of the 1910 population schedule 129
The 1910 population card 130
Comparison with 1900 card 131
Punching the cards 133
Sorting and tabulation 134
Family card proposed for 1910 135
Special hand tabulation, 1910 137
Experiment with field-punched cards 138

Chapter VII. THE FOURTEENTH CENSUS, 1920

Equipment available 139
The problem of a card punch 139
Tabulating equipment for 1920 agriculture 141
The 1920 population schedule 143
The 1920 population card 143
The occupation card 145
Punching the 1920 population card 146
Details of machine tabulation, 1910 and 1920 147
Verification runs 147
First count, 1920—Detail for small areas 152
Second count, 1920—Country of birth for small areas 154
Third count, 1920—Single years of age, etc 154
First machine 155
Second machine 156
Fourth count, 1920—State of birth 157
Fifth count, 1920—Country of birth, large areas 157
Sixth count, 1920—Mother tongue and parentage 158
The tabluation of occupations 160

Chapter VIII. THE 1930 CENSUSES

Changes between 1920 and 1930 161
The 1930 key punch—First stage 161
Second stage 164
Test of the new card 165
Changes required in machine wiring 165
Third stage—The 1930 card 166
The 1930 population schedule 169
Specifications for punching 171
Automatic gang punch 172
Details of machine tabulation, 1930 172
First count—Data for minor civil divisions 172
Second count—Age, school attendance, and marital condition 173
Third count—Country of origin 175
Fourth count—Gainful workers by industry 176
Fifth count—Country of birth and mother tongue 177
Sixth count—Marital condition, illiteracy, etc., by country of origin 178
Seventh count—Single years of age, etc 178
Eighth count—State of birth 179
The remaining counts (9th, 10th, and 11th) 179
The 1930 unemployment census 180
The unemployment schedule 180
Transcription and coding 182

Digitized by Google

The unemployment census, continued:
The unemployment card ... 183
Punching the card ... 183
Summary cards ... 185
The 1931 census of unemployment ... 186
The family card program, 1930 ... 186
The family transcription sheet ... 186
The family card ... 189
The census tract count ... 189
First count of families—Small areas ... 190
Second count—Family composition ... 190
Third count—Foreign-born white families by country of birth of head ... 191
Publication ... 191
Fourth count—Families of gainfully employed homemakers ... 191
Fifth count—Type of family ... 192
Sixth count—Number of children by age of wife ... 192
Count for secondary families ... 193
Status of counts 4 to 6 ... 194

Chapter IX. NINETEEN FORTY AND LATER

The Sixteenth Census, 1940 ... 195
Introduction of sampling ... 196
Elimination of "age unknown" ... 197
New inquiries in 1940 ... 197
Education ... 198
Migration ... 198
Employment status ... 198
The new concept of the labor force ... 199
Income ... 199
The 1940 tabulation program ... 200
The preliminary sample card (card S) ... 200
The main 100 percent population card (card A) ... 201
The sample cards ... 202
The 1940 census of housing ... 205
Further changes ... 207
Expansion of professional staff ... 207
The advent of the computer ... 207

APPENDIXES

Appendix A. Mr. Porter's London paper ... 211
Appendix B. Contemporary portraits of members of the 1890 Census Office staff, with brief comment ... 217
Robert P. Porter, Superintendent
Henry Gannett, Geographer
James H. Wardle, acting Chief Clerk
William C. Hunt, Chief, Population Division
John S. Billings, in Charge, Division of Vital Statistics
Frank R. Williams, Chief, Division of Manufactures
David T. Day, Chief, Division of Mines and Mining
Henry C. Adams, Chief, Division of Transportation
Herman Hollerith, President, Tabulating Machine Company (not a member of the Census staff).
Appendix C. "Directors" of the Census, 1790–1965 ... 221

Digitized by Google

ILLUSTRATIONS

Figure		Page
1.	1880 population schedule	2
2.	Tally sheet No. 1, 1880, much reduced	5
3.	Section of tally sheet, full size, with tallies	6
4.	Tally sheet No. 2, 1880	9
5.	Consolidation sheet for tally No. 2	12
6.	The Seaton device	19
7.	Herman Hollerith, 1904	26
8.	Dr. John Shaw Billings, 1908	28
9.	Drawings of Hollerith's first tabulating machine	36
10.	Card for Baltimore vital statistics, 1887	38
11.	Card for Surgeon General's Office, 1889	39
12.	Hollerith's keyboard (pantograph) punch	43
13.	Symbols on "keyboard" of punch	44
14.	Gang punch	44
15.	Complete card as punched for 1890	46
16.	Content of 1890 card (from reading board)	47
17.	The Hollerith electric tabulating machine	48
18.	Perspective of circuit-closing press	48
19.	Detail of circuit-closing press	49
20.	Dial board, with detached counters	50
21.	Back of Hollerith tabulating machine	50
22.	The sorting box	52
23.	Relay	53
24.	Relay circuit and counting circuit	54
25.	1890 schedule	58
26.	Tabulating machine as adapted for family count	61
27.	Hollerith automatic tabulating machine	85
28.	Cylinder for integrating tabulator	86
29.	The electric sorting machine	87
30.	Key punch used in 1900 census of agriculture	88
31.	Population card for 1900, unpunched	91
32.	Population card for 1900, completely punched	92
33.	Result slip for count B, 1900	97
34.	Result slip for count D, 1900	99
35.	Farm card, unpunched	105
36.	Farm card, completely punched	106
37.	Tabulating machines for the farm card	109
38.	Crop card, unpunched	110
39.	Crop card, completely punched	111
40.	Tabulating machines for crop cards	114
41.	Printing counters for Census tabulating machine	123
42.	Section of new result slip for tabulating machine	125
43.	Powers punch	126
44.	1910 card for population	131
45.	Family card proposed for 1910	136

Digitized by Google

46. Field-punched card for Okmulgee County, Oklahoma 138
47. Improved unit counter, automatic 140
48. 1920 population card 144
49. Commercial punch with guide card 162
50. First-stage guide card 163
51. Second-stage guide card 164
52. Third-stage guide card 167
53. 1930 population card 169
54. Unemployment card, 1930 184
55. Family transcription sheet, 1930 187
56. Family card, 1930 189
57. The main 1940 population card (card A) 201

In Appendix B: Contemporary portraits of the 1890 census staff; Porter, Gannett, Wardle, Hunt, Billings, Williams, Day, and Adams; and Herman Hollerith, President of the Tabulating Machine Co 217

Digitized by Google

Chapter I. CENSUS PROCEDURES PRIOR TO 1890

The student of the early history of census activities in the United States will readily find complete information with respect to the questions asked in the various censuses,[1] and fairly complete descriptions of the methods of collecting the data—partly because, prior to 1930, these were largely specified in the legislation authorizing the respective censuses. But with respect to the methods by which the data collected were assembled and made up into statistical tables there are no systematic records prior to 1940, nor any adequate and conveniently usable information, except as the procedures may be inferred from scattered production records, tabulation forms, and other material more or less accidentally preserved.

Early censuses; family returns.—The population census schedules from 1790 to 1840 provided one line for each family or household, with columns in which to enter the number of persons of specified classes, such as white male, under 16 years of age, etc. These specified classes were thus already counted, family by family, so that the totals for a page of the schedule could be obtained by adding the columns on the schedule itself. These were transferred to summary or consolidation sheets and further additions gave totals for each enumeration area and then for the larger areas—cities, counties, and States.

Individual returns, from 1850; the tally system.—Beginning in 1850, the census schedule provided a line for each *individual*, with columns indicating the various items of information required. And some of the questions, for example. those on civil condition or education, were so devised that they could be answered by making a checkmark in the proper position (a precursor, perhaps of the mark-sense pattern of the 1960 schedule). See figure 1, which is a copy of the 1880 schedule, reduced in size. Thus, the initial problem of tabulation became one of *counting*, rather than adding. This counting was done, from 1850 through 1880, by a system of tallying, which, by reason of the increasing number of combinations of classifications required, became increasingly complex. Only a limited number of combinations could be recorded in one tally, so it was necessary to handle the schedules 5 or 6 times, for as many independent tallies—with much duplication of the basic classifications. And tallies for specific areas often had to be repeated, in order to adjust inconsistencies in the resulting totals.

[1] Especially, for the earlier censuses, in Wright and Hunt, *History and Growth of the United States Census*, 1900.

Digitized by Google

SCHEDULE 1.—Inhabitants in ....., in the County of ....., State of .....

Page No. ..... enumerated by me on the ..... day of June, 1880.

Supervisor's Dist. No. ..... NOTE D.—In making entries in columns 9, 10, 11, 12, 16 to 23, an affirmative mark only will be used—thus ✓, except in the case of divorced persons, column 11, when the letter "D" is to be used.

Enumeration Dist. No. ..... NOTE E.—Question No. 12 will only be asked in cases where an affirmative answer has been given either to question 10 or to question 11.

NOTE F.—Question No. 14 will only be asked in cases where a gainful occupation has been reported in column 13.

Enumerator.

In Cities					Personal Description					Civil Condition				Occupation.		Health.						Education.			Nativity.		
Street.	House Number.	Dwelling-houses numbered in order of visitation.	Families numbered in order of visitation.	The Name of each Person whose place of abode, on 1st day of June, 1880, was in this family.	Color—White, W.; Black, B.; Mulatto, Mu.; Chinese, C.; Indian, I.	Sex—Male, M.; Female, F.	Age at last birthday prior to June 1, 1880. If under 1 year, give months.	If born within the Census year, give the month.	Relationship of each person to the head of the family—whether wife, son, daughter, servant, boarder, or other.	Single.	Married.	Widowed.	Divorced.	Profession, Occupation or Trade of each person, male or female.	Number of months this person has been employed during the Census year.	Is the person [on the 1st day of June, 1880] sick or disabled, so as to be unable to attend to ordinary business or duties? If so, what is the sickness or disability?	Blind.	Deaf and Dumb.	Idiotic.	Insane.	Maimed, Crippled, Bed-ridden, or otherwise disabled.	Attended school within the Census year.	Cannot read.	Cannot write.	Place of Birth of this person, naming State or Territory of United States, or the Country, if of foreign birth.	Place of Birth of the Father of this person, naming State or Territory of United States, or the Country, if of foreign birth.	Place of Birth of the Mother of this person, naming State or Territory of United States, or the Country, if of foreign birth.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1																											
2																											
3																											
4																											
5																											
6																											
7																											
8																											
9																											
10																											
11																											

FIGURE 1.—1880 population schedule, reduced in size. Actual schedule was about 15 by 17 inches and contained 50 lines

Digitized by Google

Under the tally system, it was necessary to tally, ED (enumeration district) by ED, all the detail required for any larger area. Thus even though it was proposed to publish some of the data only for States or even for the United States as a whole, the tally had to be made in complete detail by ED's and the figures added area by area, to build up to the publication areas. Incidentally, the burden of area consolidation bulked large in the work of producing tables for publication, until the adoption of summary cards, between 1930 and 1940. But even in the early stages of the use of punch cards, much of the detail of consolidating ED's, at least, was avoided by assembling the *cards* into larger packs, representing larger areas, before making the tabulation.

While there seems to be no formal record of the details of these tallies, a brief description of the content of the 1880 tallies is given in the introduction to the 1890 Compendium,[2] in comparison with the more extensive card tabulations of 1890. And in a paper read by Robert P. Porter, Superintendent of the 1890 Census, before the Royal Statistical Society in London on December 4, 1894,[3] the patterns of tabulation followed in 1880 (tally) and in 1890 (card tabulation) are set up in parallel columns and in more adequate detail. With these outlines, it has been possible, working back from the published tables, to reconstruct the tallying program of the 1880 census.

One tally mark was usually required for each person reported on the schedule; and one tally spot on the tally sheet was provided for each combination of characteristics called for. The following paragraphs are based on "constructive" tally sheets, designed to produce, with a minimum of effort, the tables that were published for 1880. It is believed, however, that they represent, quantitatively, at least, what must have been done in 1880 and thus provide an almost essential background against which to evaluate the advantages of the punchcard procedures adopted for 1890.

In the interests of simplicity and directness, these constructive tally sheets and their accompanying instructions are presented in the form of positive specifications and instructions—to avoid the disturbing effect of the frequent use of justifying expressions like "it must have been done this way" or "this would have been the logical procedure."

It is possible that the tallying was done, at least in part, by clerks working in pairs, one reading the items from the schedule and the other entering the tally marks. This, however, would involve translating the written data into spoken words and then translating the spoken words back into written tallies. And it seems evident that 10 clerks working each with a schedule and a tally sheet would accomplish decidedly more

[2] *Compendium of the Eleventh Census, 1890*, Part I, Population, p. xix.

[3] *Journal of the Royal Statistical Society*, Vol. 57, Part 4, December, 1894, pp. 669–673. The significant part of this paper is reproduced in Appendix A.

Digitized by Google

in a given time than five pairs of clerks, one reading and the other tallying. It is assumed, therefore, that the work was done by individual clerks working independently; and in some instances the proposed tally sheets have been designed especially to facilitate this method of operation. Note, for example, the location of columns for the less frequently occurring classes at the *left*, in spite of the fact that these columns would normally stand at the right in the final tables.

THE 1880 TABULATION PROGRAM

Without doubt the very first count of the population returned in the 1880 census was made by recording, sheet by sheet, the numbers of persons reported. Each normally completed sheet represented 100 persons. This is the procedure which was followed in later censuses, from 1900 or 1910 to 1940. For 1890, because there was a separate schedule for each family, another method of counting had to be adopted. (See page 61.)

The First Tally—Sex, Color, and Nativity

The first tally for 1880, by which certain basic classifications of the population, in addition to its total number, were obtained, was a very simple one. It provided the numbers in four (or five) race or color groups, the numbers of males and females, the number of native persons, and the number of foreign born. The most extensive publication from this tally took a relatively condensed form: First, three tables showing by States and counties and for cities and towns of 4,000 or over, the population by race alone; then another series, by nativity alone; and finally, for States only, color or race by nativity by sex.[4] This completed the only publication of the 3-way classification, since all the nonwhite classes were combined in the later more detailed tallies.

The first tally sheet.—The tally sheet which has been designed to furnish this 3-way classification is shown, much reduced, in figure 2, with a small section in full size, with tallies, in figure 3. The columns provide for the classification by color or race and sex; the upper section of the sheet is for native persons, and the lower section for foreign born.

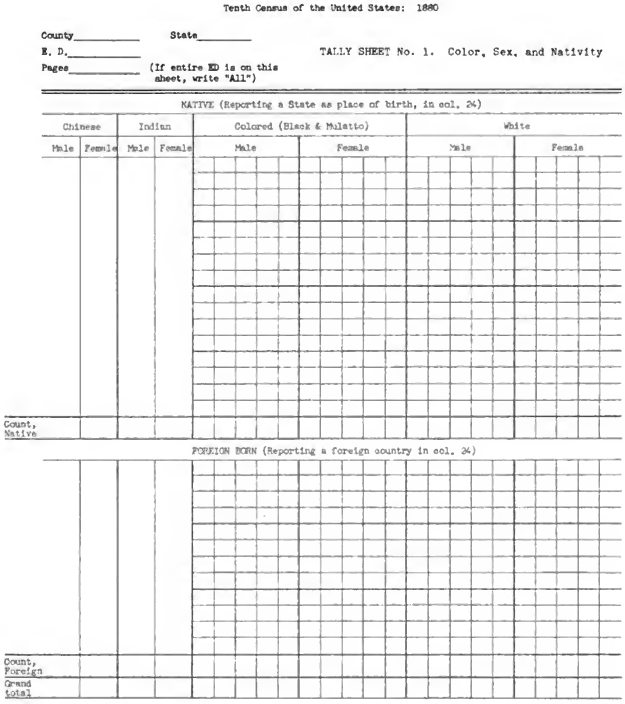
Note that on this tally sheet the columns for colored are placed at the left, since in most areas they will be used much less frequently and may therefore be placed in the less convenient part of the sheet, that is, farther from the schedule-source. In the final tables the data for colored will normally follow those for white, native and foreign born.

The form which is presented in figure 2 was designed for use in areas with considerable colored population; for other areas it might be well to

[4] *Tenth Census of the United States, 1880, Volume I, Population*, tables IV to IX, and tables XVII to XIX, pp. 377–456 and 542–545.

Digitized by Google

print the sheet in a less elaborate form, providing, perhaps, two clear columns only for colored males and females, in place of the elaborate sections shown in the complete form.


Tenth Census of the United States: 1880

County_____ State_____

E. D._____ TALLY SHEET No. 1. Color, Sex, and Nativity

Pages_____ (If entire ED is on this sheet, write "All")

NATIVE (Reporting a State as place of birth, in col. 24)

	Chinese		Indian		Colored (Black & Mulatto)		White	
	Male	Female	Male	Female	Male	Female	Male	Female
Count, Native								

FOREIGN BORN (Reporting a foreign country in col. 24)

Count, Foreign								
Grand total								

FIGURE 2.—Tally sheet No. 1, 1880, much reduced

The method of using this tally sheet can most readily be presented in the form of direct instructions for the tallying, counting, and consolidation, as follows.

Instructions for tally No. 1.—Enter county, State, and ED number in the upper left corner of the tally sheet. The entry for "Pages" will be made when the sheet is completed.

Take the first page of the schedule on a desk or table and place the tally sheet over the first three columns, so that the right-hand edge is

Digitized by Google

just to the left of column 4. Provide also a narrow strip of cardboard (about 2 × 10 inches) to assist in following the schedule lines across, especially from line 5 to line 24. Each line of the schedule represents one person.

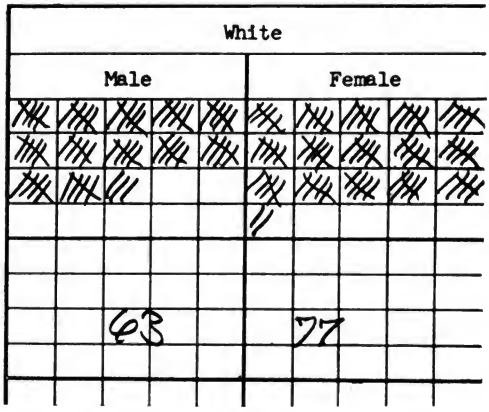


FIGURE 3.—Section of tally sheet, full size, with tally marks

Make one tally for each line; that is, each line on which there are any entries. The location of this tally on the tally sheet is determined by the entries in schedule column 4 (color), column 5 (sex), and column 24 (place of birth). The columns on the tally sheet provide for the classification by color and sex; the upper section of the sheet is for native persons; that is, for persons born in some part of the United States, as indicated in schedule column 24, and the lower section for foreign born persons; that is, those reporting some foreign country as place of birth in column 24.

For the first tally, make a vertical, or slightly slanted mark (/) in the first of the little squares in the proper column. For the second tally in the same column, make a second mark, close to the first; and likewise for the third and fourth; for the fifth tally in any square make a diagonal line across the first four, thus (𝍸). Proceed across the column, filling the five squares on the first line before putting any tallies on the second line. In the columns for Indians and Chinese or Japanese, where there are no printed squares, make the tallies in groups of 5, spaced as may be convenient in view of the frequency of returns for these classes.

Digitized by Google

It will be easy to determine, from the replies in schedule columns 4 and 5, in which of the tally sheet columns the tally should go. But to determine whether it goes in the upper (native) section or the lower (foreign born), is not quite so simple, since column 24 shows the birthplace in great detail—either a State in the United States or a specified foreign country. For this tally you must consider as "native" any person whose place of birth is reported as a State, and as "foreign born" any person whose place of birth is reported as a foreign country, and place the tallies correspondingly. Thus, for a person with entries of "W" in column 4, "F" in column 5, and "Germany" in column 24, you will make the tally in the last broad column on the sheet, in the lower section, indicating a foreign-born white female.

Assuming that no "editing" has been done, you will occasionally find a schedule on which some of the entries are incomplete. These are to be handled as follows: In the case of a person for whom there is no entry in column 4 (color) or column 5 (sex), consult your supervisor who will supply the missing entries on the basis of general instructions—color by reference to other members of the family; sex usually by reference to first name; etc. Any white person or Negro or Indian for whom no place of birth is given should be tallied as native; any Chinese with no report, as foreign born. A person reported as born at sea under the U.S. flag is to be counted as native.

You will have little occasion to use the columns at the extreme left of the tally sheet, since Chinese or Japanese and civilized (nontribal) Indians are found only now and then, except for a few areas where they are concentrated;[5] and relatively few occasions to make tallies for colored persons in the "foreign born" section of the tally sheet. It is important to record these classes with care, however, since they are required to make up the totals of native and foreign born population.

In most cases a whole ED can be tallied on one tally sheet; and on its completion the word "All" may be entered in the tally sheet heading, to indicate this fact. If an ED is too large for a single tally sheet it should be divided into two or more sections; then on each of the sheets required should be entered the schedule page numbers covered, and also the number of sections into which this ED is divided.

Counting the tallies.—The counting of the tallies is to be handled as a separate process, normally by different clerks.

The tallies are arranged in such fashion as to make the counting easy. First, each completed block (for white and colored) contains 100 tallies; each completed line within a block contains 25 tallies; and the major part of the incomplete lines can be counted by fives. Thus, if there are three complete blocks, that makes 300; two additional

[5] The numbers of these minor classes reported in the entire United States in 1880 were as follows: Chinese, 105,465; Japanese, 148 (counted with the Chinese and footnoted); Indians, 66,407; and foreign-born Negroes, 14,017.

Digitized by Google

complete lines make another 50, or 350, so far; and three fives and two single tallies on the next line make 17 more, or 367 in all. Make these counts very carefully. One mistake in counting can introduce a much larger error into the result than a mistake in tallying.

The number of tallies in each column of the tally sheet is to be recorded on the lines labeled "Count" at the bottom of the sections. The count line in the first section will represent the native population of the ED classified by color and sex; and likewise the count line at the bottom of the second section for the foreign born. Then the figures for the native and foreign born are to be added and the results entered on the final line of the tally sheet, to represent the total population classified by color and sex. By way of partial verification of this addition, the three count lines may be cross-added and the sum of the first two totals checked against the third.

Totals for counties or other areas made up of groups of ED's can conveniently be made by arranging the tally sheets for all the ED's, overlapping, so that only the bottom lines appear, and then adding the columns of figures thus provided. In fact, it may sometimes be advantageous to obtain larger area figures for total native and total foreign born by a similar process, folding the sheets back so that the lines for native or foreign born appear at the bottom of the fold.

Other consolidations, such as those for total males and females, or totals by color or race, can best be made for areas larger than ED's, after the initial consolidation of ED's has been completed.

The Second Tally—Single Years of Age

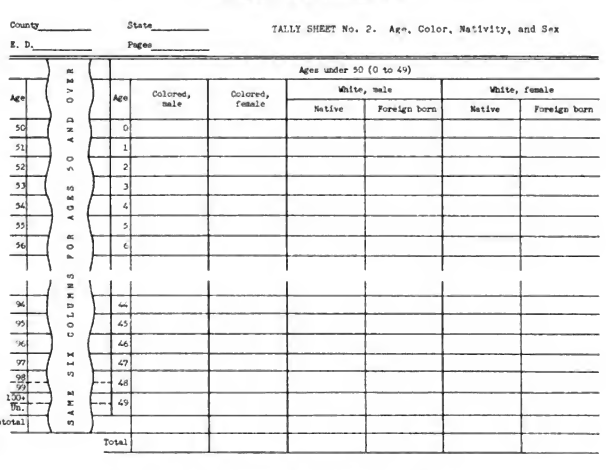
Far more nearly typical of the task of tabulation through tallying is the reconstructed tally sheet for the second tally (age, color, nativity, and sex) presented in somewhat condensed form in figure 4. This tally distinguished single years of age, by sex, within each of the three color-nativity classes: Native white, foreign-born white, and colored. This last included, for the second and subsequent tallies, both Negro and the minor groups, Chinese, Japanese, and Indian, and both native and foreign born.

To provide for all of this detail, this tally sheet must afford roughly 600 tally spaces—slightly over this number, to take care of minor incidental groups, like persons 100 years old or over and persons with no report on age—"age unknown," as traditionally presented in the census reports. Since a sheet 100 lines deep would be utterly inconvenient to handle, this tally sheet is set up in two parts, the first (left-hand) part covering ages from 50 to 100-plus, and the second, ages from 0 to 49, this being placed at the right; that is, nearer to the schedule from which the data are taken, because entries in this age series are far

Digitized by Google

more numerous than entries in the older series. This reverses what might be thought of as the normal sequence, for reasons of temporary convenience.

The columns indicating color, nativity, and sex, six columns in each section of the sheet, are similar to those in the main part of tally sheet No. 1, but the sheet is ruled in relatively narrow lines (⅓ inch), with the successive ages printed in the left-hand "stub" of each section and with heavy cross-rules for each group of five lines. The columns are 1⅓ inches wide; and the tally spaces (⅓ by 1⅓ inches) are left clear without any attempt at interior ruling—partly because the numbers to


Tenth Census of the United States: 1880

County_____ State_____ TALLY SHEET No. 2. Age, Color, Nativity, and Sex

E. D._____ Pages_____

Age	SAME SIX COLUMNS FOR AGES 50 AND OVER	Age	Ages under 50 (0 to 49)					
			Colored, male	Colored, female	White, male		White, female	
					Native	Foreign born	Native	Foreign born
50		0						
51		1						
52		2						
53		3						
54		4						
55		5						
56		6						
96		44						
95		45						
96		46						
97		47						
98 to 99		48						
100+ Th.		49						
Subtotal								
		Total						

FIGURE 4.—Outline of tally sheet No. 2, 1880

be tallied in any one tally spot will be relatively small. This sheet, containing 12 wide columns and 50 lines, would be about 17 inches wide and 20 inches deep, or about the same size as the 1880 schedule. It must not be assumed, however, that the tally clerk would have to hunt over the whole area of this sheet in every case to find the proper tally spot; for by reason of the age distribution of the population, the entries will be rather heavily "bunched" in the right-hand section of the tally sheet (nearest the schedule from which the data are being taken), and largely in the upper part of the sheet.

Digitized by Google

Instructions for tally No. 2.—Enter county, State, and ED number in upper left corner of tally sheet. The entry for "Pages" will be made when the sheet is completed.

Put the first page of the schedule on a fairly large desk or table and place the tally sheet over the first three columns, so that the right-hand edge is just to the left of column 4. Provide also a narrow strip of cardboard (about 2 by 10 inches) to assist in following a line across the schedule, especially from column 5 to column 24.

One tally mark is to be made on the tally sheet for each person listed on the schedule. The tally sheet is divided into columns and lines—one column for each color-sex-nativity class and one line for each age. The column to be used depends on the entry in schedule columns 4, 5, and 24 (column 24 for white persons only) and the line depends on the entry of age in column 6. The right-hand section of the tally sheet provides space for ages under 50 and the left-hand section for the less frequent entries of ages from 50 to 100-plus.

First note the color, sex, and age, as reported in schedule columns 4, 5, and 6, then find on the tally sheet the space corresponding, the line for the age and the column for color, sex, and nativity. For a colored person (any entry except "W" in column 4), male or female, there will be only one pair of columns and the tally may at once be entered in the first or second column of the proper section of the tally sheet on the line showing the given age.

For the first tally, make a vertical or slightly slanted mark (/) in the upper part of the space, at the extreme left. For the second tally in the same space, make a second mark, close to the first; and likewise for the third and fourth; for the fifth tally, draw a diagonal line across the first four, thus (𝍸). Put the second group of five tallies directly under the first, so that the tally groups can readily be counted in vertical pairs, or by 10's. It will usually be desirable to leave space at the right in the tally space for the count, which will be written in later.

For a white person there are four possible columns in which to tally, and it is necessary to note not only the sex, in schedule column 5, but also the nativity (whether native or foreign born) by reference to column 24. This column does not show the required classification directly, as do columns 4 and 5, but you must consider as native any person whose place of birth is reported as a State, and as foreign born any person whose place of birth is reported as a foreign country, and place the tally mark accordingly. Thus, for a person with entries of "W" in column 4, "F" in column 5, and "Germany" in column 24, you will make the tally in the last column of the proper section of the tally sheet—the very last column, if the age is under 50—under the heading "White female, foreign born." If no place of birth is given in column 24, tally as native.

Digitized by Google

Special cases: If there is no entry in column 4 or in column 5, consult your supervisor, who will supply the missing entries (color by reference to other members of the family; sex by first name; etc.).

For missing or unusual ages, note the divided spaces indicated in the lower left corner of the tally sheet; tally age 98 in the upper part of the next-to-the-last line, as indicated by the position of the figure in the age column, and age 99 in the lower part of the same ruled line. Tally an age of 100 or more in the upper part of the last ruled line, and age not reported (no entry in column 6) in the lower part, following the symbol "Un." (Unknown ages were distributed in the 1880 reports; but they must have been counted first and then distributed on some pro-rata basis—a tremendous task.)

Upon completing an ED, make the necessary entries after the ED number in the heading of the tally sheet—usually the pages of the ED covered in the tally sheet, since an ED will often take more than one sheet.

Counting and consolidation.—Count the tally marks in each tally space in tally sheet No. 2. Count the pairs of completed tally sets by 10's, add the odd tally marks, and enter the count in red ink (or red pencil) in the extreme right of the space. Add the counts in each of the 12 columns and enter the totals on the subtotal line; then add the subtotals for each color-nativity class and enter final area totals on the bottom line of the tally sheet. These totals are to be checked against the corresponding totals established in the first tally.

The consolidation of this tally sheet (ED's into counties or counties into States) is bound to be very complicated and to occupy large sheets of paper, however it is handled. But the whole single-year detail has to be consolidated into successively larger geographic areas, even if the only completely detailed figures to be published are those for the United States.

By reason of the importance of the consolidation process in the tabulation procedures, especially when the initial counts are made by ED's, an outline of one specific method by which the consolidation of tally sheet No. 2 might have been handled is presented herewith. The proposed consolidation sheet is illustrated in figure 5.

This consolidation sheet comprises two sections, section A for ages 0 to 49, and section B for the remaining ages, plus some summary columns. The boxheads of section A carry the ages from 0 to 49, with interpolated columns for 5-year group totals, as indicated in figure 4. In section A the columns will be of equal width (about $\frac{1}{8}$ inch), but in section B the few last age columns, for which the counts will be very small, may be made narrower, to provide space for the final summary columns, as indicated. With unit age columns $\frac{1}{8}$ inch wide and line spaces $\frac{1}{4}$ inch, a 60-line sheet will measure about $28\frac{1}{2}$ by 18 inches.

Digitized by Google

Instructions for consolidation sheet.—Enter in the heading of each section of the sheet the necessary geographic identification, usually the area covered and the ED's required to make it up.

Note that the general pattern of transcription from the tally sheet is to enter a column of figures from the tally sheet onto a line on the transcription sheet. This seems to be the most advantageous arrangement for the whole task of consolidation, since lines of figures are easier to manipulate and their groups more flexible, than columns.

Tenth Census of the United States: 1880

CONSOLIDATION SHEET FOR SECOND TALLY, Section A

Area _____ comprising ED's _____

Figures in column heading indicate ages

Cl & ED	0	1	2	3	4	0-4	5	6	7	8	9	5-9	10	Etc. to	48	49	45-9	Total
WM-n 1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		
WM-f 1																		
2																		
3																		
Etc.																		

Final columns of Section B:

97	98	99	100	Un	Total	Sec. A	Gr. total

FIGURE 5.—Consolidation sheet for tally No. 2

Assemble, first, the tally sheets for all ED's in the county (or other target area).

Enter, first, in the stub of section A, a convenient symbol for the first color-nativity class, placing the four white classes here, ahead of the two colored classes, thus: WM–n, WM–f, WF–n, etc.

Under this first heading, transcribe line by line the corresponding columns of counts for the first ED; then for the second ED; and so on until the series for the county is complete, listing the ED numbers in

Digitized by Google

the stub, under the class designation. The resulting block of figures will contain all the age counts, from age 0 to age 49, for the first population class (WM–n).

Then enter in the stub, leaving a line or two blank for the class totals, the second class designation, WM–f, and continue with the counts for this class. If there are no more than 12 or 15 ED's in the county, the list of ED's can be repeated 3 times on a sheet, thus taking 2 pages for the area; a county with 25 ED's will require 4 pages.

Presumably it will be better, once the pattern is established and the number of sheets required for the county or other area is known, to make up the whole set of sheets for an area before transcribing any figures.

Upon completion of section A, proceed in the same manner with section B, containing the ages from 50 to 100-plus and age unknown. The pattern of the stub entries will, of course, be the same in the two sections.

Upon completion of the entries, add each sheet across and vertically, and enter sheet totals. Then enter the totals of the 5-year groups, in red ink, and add across and vertically. If the two sets of totals agree, this may be considered a verification of the additions.

Finally, transfer the column of sheet totals from section A to the designated column of section B, and add to get the population totals, by class, which may be checked against the class totals from tally No. 1.

The Remaining Tallies, in Brief

Tally No. 3—State or country of birth.—This tally sheet is relatively simple, since only one or two characteristics are involved, but it is extensive, by reason of the large number of places for which data have to be recorded. There would be required 156 tally spots in all, as follows:

38 States and 9 territories for natives, white and colored	94
62 countries for foreign born	62
Total	156

The sheet might well comprise two sections, set side by side, like the two sections in tally sheet No. 2, the right-hand side for natives by color and State of birth, with a wide "column" (perhaps 5 or 6 inches wide) for white and a narrower one for colored, and with the States and territories listed in the stub. By reason of the very irregular incidence of the reports for State of birth, there should be different printed forms for different areas, with a wide (deep) line for State of residence, intermediate spaces for nearby States, and narrower spaces for more distant States.

By reason of the large number of foreign countries for which data were tabulated, the left-hand section might be set up in two columns,

Digitized by Google

each with stub for country and space for tally marks, the list of countries running over from the first column to the second. Here again the line spaces might vary in proportion to the returns expected—a wide space for Canada and a very narrow space for Other Africa. The entire sheet might be no larger than 15 by 20 inches.

The tally clerk would note first the place of birth, in schedule column 24; then for a State reported, look back to column 4, for color; or perhaps in some areas, he might note that there were no colored persons reported on the schedule and tally all persons directly by State in the white column.

If the place of birth was a foreign country, the tally would be made immediately, with no further difficulty except to find the designated country among the countries presented in the stub.

Tally No. 4—Place of birth of parents.—This tally, presumably the last one undertaken, was completed for only 28 States, 7 territories, and the District of Columbia, plus the city of New York, representing a little over one-half the population of the country—the areas apparently *not* selected on the basis of probable percentage of foreign birth or parentage.

On the basis of the ratio between the tallied-area totals for persons with father or mother born in a specified country and the number of foreign born from that country in the same area, totals were estimated for the States not tallied, and thus for the entire United States.[6] This may well be the first instance in which official census figures were based on a sample.

Additional tables show, for each of the tallied areas, the number of native persons (born in the United States) and the number of foreign born (persons themselves born in a foreign country), by country of birth of father; then each father-nativity group subclassified by country of birth of mother, providing such combinations as "father born in Germany, mother born in Ireland, etc." The list of countries (or groups of countries) for which data are shown is very short, however, comprising only the following:

United States
Ireland
Germany (the German Empire)
Great Britain
Scandinavia
British America
Other countries

The typical table in this series consists of 7 columns (or 8, including the total) for the countries of birth of mother, with 7 (or 8) lines, one

[6] *Tenth Census of the United States, 1880*, Vol. I, Population, table XXIV, p. 678. The results of the cross-classification of country of birth of father by country of birth of mother are shown on pp. 675 and 680–692.

Digitized by Google

for each country of birth of father.[7] This form appears twice in each table, once for native persons and again for foreign born.

The tally sheet might well have been set up in almost this exact form, with 2 blocks of tally spaces, 7 spaces wide and 7 spaces deep—possibly one block, at the right, for native persons, and a second block, at the left, for the less numerous foreign born. This would make only 98 tally spaces, but the tally is much more difficult than one might infer from this relatively small tally sheet, since many individually reported countries must be assigned to one of the specified country-groups. There was provided, of course, a list of the individual countries in each group, so that the allocation could be quickly made.

For convenience in tallying, it would be better to set up the tally sheet with a column for each country of birth of father and a line for each country of birth of mother, since the data for father appear first on the schedule. With this change from the table form, the instructions for tallying would be relatively simple, as follows:

Note first the country of birth of the person, in column 24; if United States, then the tally goes in the "native" section of the tally sheet; if a foreign country, the tally goes in the "foreign born" section. Then note the country of birth of father, in column 25; this will determine the column in which the tally goes. Then the country of birth of mother, in column 26, which will determine the line; place the tally on this line, in the column already determined for the birthplace of father.

For countries other than those specifically listed, consult the grouping list provided.

Since there are no figures published for areas less than States, the consolidation of the tallies (necessarily made for ED's grouped into fairly small combinations, to facilitate checking) might be set up on a purely mechanical basis rather than on actual geographic areas, with possible economy of time.

Tally No. 5—Gainful workers by occupation, sex, and age (3 groups), and by country of birth.—This is the most complicated and extensive of the tallies required for the 1880 census, though the gainful workers numbered only 17,392,099, or about one-third of the total population. *Two* tallies were made for each worker, one for the age-sex classification and one for country of birth.

Since there are 235 occupations involved, the tally sheet would normally have a line for each occupation, even though this necessitated 3 or 4 pages for a single "sheet" of tally. This would require the tally clerk to look sometimes on one page and sometimes on another to find the tally spot for a reported occupation; but there seems to be no way to avoid this.

---

[7] *Tenth Census of the United States, 1880*, Vol. I, Population, table XXVII, pp. 681–699.

Digitized by Google

All the remaining detail could be taken care of in a series of columns making up a not overwide page, as follows:

	Columns
Sex and age (10–15, 16–59, and 60-plus)	6
Place of birth, including United States and six foreign countries or groups (the groups of the Fourth Tally)	7

Since the returns in most areas would be heavily concentrated in a certain few occupations, the line spaces for these occupations would be made wider (deeper) than the line spaces for occupations less frequently reported.

In making the tallies (always remembering that each person gets two tallies) the tally clerk would first refer to the occupation returned in schedule column 13, then look back to columns 5 and 6 for age and sex and make the first tally in the proper column—unless the person happened to be under 10 years of age, in which case he would be omitted as not properly considered a gainful worker; then the tally clerk would look in column 24 for the place of birth, and make the second tally (again often requiring the determination of the proper group for the grouped countries) in another column on the same line of the tally sheet.

This tally offers special difficulties, in that the number of occupation designations found on the schedules far exceeds 235, so that the tally clerk must often decide under which of the 235 listed occupations (or occupation groups) a reported occupation must be counted. (This assumes no advance "editing" or coding of the schedules.)

Tally No. 6—Illiteracy.—The proposed tally sheet for illiteracy will comprise 12 columns; 1 set of 6 columns, at the right, with headings for color, sex, and nativity, like those shown on tally sheet No. 2, all under the heading "Entries of No–No in columns 22–23," representing persons not able either to read or to write; then 6 similar columns, at the left, under the heading "Entries of Yes–No in columns 22–23," representing persons reported as able to read but not to write.

Under these headings, age groups are indicated in the stub—10–14, 15–20, and 21 or over—with very deep sections across the columns. For convenience in counting, the entire area under each main heading may be ruled off in little squares, as shown for tally sheet No. 1 in figure 2, above.

The tally clerk will first look for entries of No–No or Yes–No in schedule columns 22–23, since tallies are to be made *only* for such entries. Then he will note color, sex, and age in columns 4, 5, and 6; discard any case with age under 10, and, for a colored person (any entry except "W" in column 4), tally at once in the proper column (colored male or female).

For a white person, remembering the age and sex, he will look in schedule column 24 for the nativity and tally as foreign born if there is a

Digitized by Google

foreign country in column 24; or if there is a State in column 24 (or no entry in column 24), he will tally in the column for native. Note that this tally is much more difficult than one might judge from the small number of tally spots and the small fraction of the total population to be tallied.

The same form of tally sheet could be used for tallying schedule columns 22 and 23 independently, though it would be a more difficult tally, in addition to the 5 million additional tally marks required. Note that the last census to count illiteracy (1930) used one combination question, "Able to read *and* write, Yes or No."

THE SEATON DEVICE

Frequent reference is made in the early literature to the Seaton device which was used in the compilation of population data during the latter part of the 1870 census and throughout the 1880 census period. This device was invented and patented (Patent No. 127,435, June 4, 1872) by Charles W. Seaton, chief clerk during the 1870 census, in charge of the New York State census in 1875, again chief clerk in 1880, and then, from 1881 to 1885, Superintendent of the Census. Fundamentally, Mr. Seaton's invention, for which he was paid $15,000 under a special Act of Congress in 1872, was a device for making entries in not more than 8 columns or lines, set close together on a long roll of paper running over the rollers of the device, in such fashion that the figures in a series of columns or lines, entered conveniently within a small space, would be intermingled in compact blocks for addition when the roll of paper was removed and cut up for summation.

This machine, if one might apply the term "machine" to so simple a construction, was made of wood and contained a roll of paper which unwound from one of the larger rollers near the bottom, back and forth over two series of small rollers, one series located at the top of the machine and the other near the bottom, and finally wound onto the second large roller at the bottom, as shown in figure 6.[8]

The object of the machine, as indicated above, was to condense a lengthy tally sheet or consolidation sheet so as to present a small surface on which could be entered items relating to six or eight different classes of data. With a partial turn of the winding roller the paper advanced and exposed on the series of rollers at the top another series of columns (or lines) on which further entries were made. Upon completion of the area (or other assignment) the paper, taken out of the machine, would show solid blocks of columns (or lines) one for each class of data, in convenient form for addition.

[8] Tradition has done much for this simple device. It is even referred to in a current business magazine as "the first mechanical tabulator which simultaneously registered horizontal and vertical sums."—*Newsfront* (Management's News Magazine), July–August, 1964, p. 34.

Digitized by Google

Following is a detailed description of the device, taken largely from the text of Mr. Seaton's patent, and referring frequently to the drawing, which is also reproduced from the patent in figure 6.

The object of this invention is to form condensed tables of figures or characters with rapidity; and its nature consists in the method of bringing the widely separated columns or parts of the paper into close proximity.

In the accompanying drawing, Figure 1 is a perspective view; Fig. 2, a longitudinal vertical section of one form of my invention; and Fig. 3 is a perspective view of the drawing roll and its paper-holding flap.

A A are the two sides of a frame or case, made of wood or other suitable material, which are connected by cross-bars *a*, *a*, *a*, and *a'*. Mounted in suitable bearings in this frame is a roll of paper, B, which has been ruled in such lines and columns as the character of the work requires, and evenly and solidly wound; *b b b* are a series of small rolls or bars mounted in the upper part of the frame, and *c c c* are simliar rolls in the lower part of the frame. These rolls *b* and *c* may be fixed or revolve in their bearings, and may be placed at fixed distances apart or made adjustable, as desired; *d* is a guide-roll in the lower part of the frame. C is a receiving-roll, upon which the paper is wound, and by which it is drawn through the apparatus. D is a handle attached to the shaft of the roll C; and E, a similar handle attached to the shaft of the roll B; *e e* are tension or friction-straps passing over the shafts of the rolls B and C. The cross-bar *a'* of the frame as also the upper edges of the frame A have graduated spaces for the insertion of the names of the divisions upon the schedule to be tabulated. The lines upon the bar *a'* corresponding with the ruled lines of the paper, and those upon the edges of the frame coinciding with the centers of the spaces between the rolls *b b b*.

The operation is as follows: The end of the ruled paper on the roll B is drawn over and under the rolls *b c*, as clearly shown in Fig. 2, over the guide-roll *d*, and to the drawing-receiving roll C, and fastened to it by means of a suitable flap, *f*, gummed to the roll, as shown in Fig. 3. The apparatus is then ready for the tabulation. The operator, having the apparatus placed in convenient position before him, and also the schedule to be tabulated, reads the first item of the schedule, and then makes a check or other mark upon the space on the paper on one of the rolls *b*, which corresponds in character with the item, as indicated by the spaces upon the bar *a* and the edges of the box or frame. After having checked all the items upon a page of the schedule, or filled any one of the columns, a column-line is drawn upon the paper at the side of each roll *b* by resting the pencil upon each adjoining roll and using it as a rule. The drawing-roll C is then turned, by its handle, in the direction shown by the arrow, sufficiently to cause the paper to move over the rolls *b* and present new columns to be checked in a smiliar manner.

It is evident that, for the specific work on the census, one might well substitute the word "tallied" or "entered" for the word "checked" in the preceding paragraph from the patent.

There is in the patent this further note on the dimensions of the device:

On the rolls shown in the model the columns resting on any pair of the rolls *b* are only three-fourths of an inch apart, but with the paper out of the machine, the same columns are fifteen inches apart.

An early record [9] states, however, that the machines used in the census provided a space 10 by 15 inches on the top and that they were

[9] Walter F. Willcox, *History of American Census Methods* (unpublished manuscript, 1914).

Digitized by Google

15 inches deep—dimensions somewhat larger than one would infer from the data provided by the patent.

The Seaton device used for tallying.—The most frequent reference to the Seaton device assumes its use in the initial process of tallying. But since the number of different classifications to be recorded in most of the

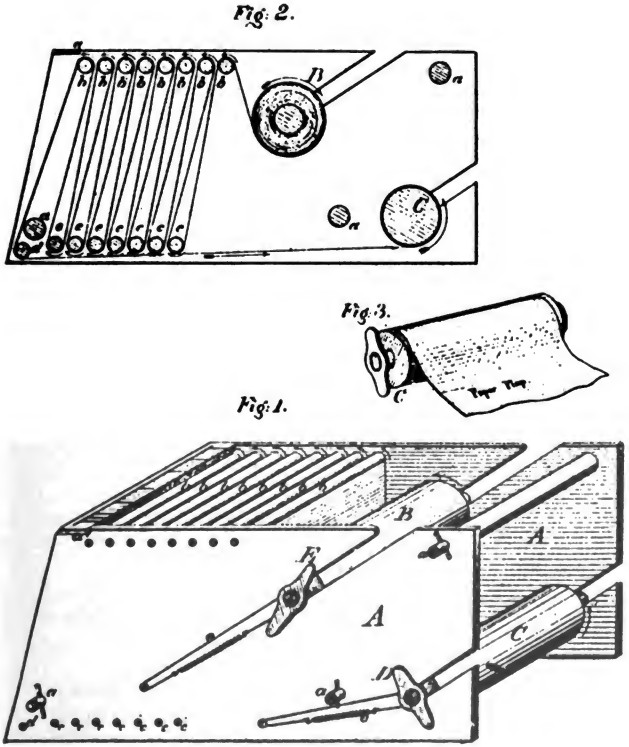


FIGURE 6.—The Seaton device. Drawing reproduced from Patent No. 127,435

1880 tabulations was far beyond the number of columns afforded by the device, it has been difficult to envisage the details of such tallying processes. (No specific current instructions for the use of the Seaton device seem to have survived.) Even the very simple first tally, by

Digitized by Google

color, sex, and nativity, calls for recording the population in 8 color-nativity classes, by sex, making 16 classes in all, or far more than the simple capacity of the device. Fortunately, however, 10 of these 16 classes are of minor importance and infrequent occurrence in most of the tabulation areas. Hence the device might have been set up, assigning one column (one roller) to each of the six major classes with a supplementary sheet provided, on which to record the infrequent returns of Chinese, Indians, and foreign-born Negroes.

Thus, the first two columns would be used for white males, native and foreign born, the second pair of columns for white females, native and foreign born, and the third pair of columns for counting all colored (nonwhite) persons, male and female. These columns would take care of all possible combinations; and the necessary supplementary information on those persons other than native Negroes who would be tallied in the nonwhite columns could be recorded also on a supplementary record sheet providing for the following 10 classes:

Negroes, foreign born, male and female.
Chinese, native and foreign born, male and female.
Indians, native and foreign born, male and female.

Under this pattern of operation, the roll of paper, when taken out of the machine, would show, first, a solid block of columns containing tallies of native white males, then a solid block of tallies of foreign-born white males, and so on. In other words, the several columns of entries, made conveniently close together, would appear on the completed sheet as blocks of similar data, with a space of 15 inches or more between the beginning of the first block and the beginning of the second, etc. And the small numbers of foreign-born Negroes, Chinese, and Japanese, already included in the total colored block, would appear in detail on the supplementary sheet.

It is obviously easier to make the entries in six adjacent columns than to range over a large sheet to find the separate locations for the entries in the gradually accumulating blocks of figures (or tally marks) which are the object of the transcription.

The process of further consolidating the tallies and counts for the initial areas (presumably ED's) is roughly the same, starting with the Seaton sheets, as from the tally sheets discussed earlier—though the tally sheets have a certain advantage in being more uniform and much more completely and certainly labeled. And the tally sheets proposed above for the first tally, at least, are not really "large."

In order to provide adequate material for comparison of the tally sheet with the Seaton device as adapted for tallying, the following outline of probable procedure with the Seaton device is presented.

Digitized by Google

Instructions for first tally on Seaton device.—Set up the Seaton device, with plain paper, with only six rollers in use, to make six columns for tallies, a column on each roller.

Write vertically, up, in the first column, the ED number, county and State, then advance the paper just enough to leave the first column clear for tallies.

At the top of each column, enter brief designations for the six classes, as follows:

1. WM–n, white male, native
2. WM–f, white male, foreign born
3. WF–n, white female, native
4. WF–f, white female, foreign born
5. CM, colored (nonwhite) male
6. CF, colored (nonwhite) female

Provide a narrow strip of cardboard, about 2 by 10 inches, to make it easy to follow across the schedule from column 5 to column 24 and also to help keep track of the lines as they are tallied. Mark on this strip the location of the significant columns (4, 5, and 24), and keep the left-hand end of it even with the left margin of column 4.

Color and sex are reported in columns 4 and 5 on the schedule; and nativity is indicated in column 24; the entry of any State indicates a native person, and the entry of any foreign country indicates a foreign-born person. If column 24 is blank, count the person as native.

Beginning at the top of the proper column, make one tally mark for each person, using a short vertical or slightly slanting line, thus (/). For the second tally in the same column, make a similar mark, close to the first, and so on with the third and fourth; for the fifth tally, draw a diagonal line across the four tallies already made, thus (𝍸). Place the second group of 5 tallies close to the first group and directly under it, so that the tallies may be readily counted in blocks of 10.

Proceed with the tallying until the longest column is full of tally marks, then draw a line down at the right of each column, using the next roller as a ruler, and enter at the bottom of each column, in small figures, in the left margin, the sheet and line number of the last line tallied, thus 5–17. (This is needed, for example, in case of inconsistencies which require retallying.) Then advance the roll of paper and start a new column.

Eventually, when the roll of paper is filled up, or when the assignment of ED's is completed, the paper will be removed from the machine and cut up into sections for counting and consolidation.

Count the tallies in each column, counting by tens and adding the odd tallies, and enter the counts evenly at the bottom of the sheet. Then cross-add these figures, to get the total of the class represented for the area tallied.

Digitized by Google

An ED will not require more than three or four columns; that is, three or four ¾-inch advances of the paper, whereas there are at least 15 inches of paper (perhaps up to 30) between the column on the first roller and that on the second. If we simply skip one or two column widths and proceed with another ED, the several ED's will be intermingled on the sheet when it is taken out of the machine. Since the first block is completely labeled and the other blocks will follow in order, this is not a fatal disadvantage; but it is a disadvantage, since theoretically the machine should provide solid blocks of homogeneous data, with all the data for a given area in adjacent sections.

Except for the need for ED figures, this tally might be made for a whole county, with the ED's thrown together consecutively on the sheet, perhaps taking a new column for each new ED, but making one count for the county. But, since this tally should be checked against the first count of the population, the hand count, ED figures are required.

Comment.—It is practically certain that the Seaton device was used in making the first tally; and that a tally by color, sex, and nativity was actually done first, in spite of the fact that it was largely duplicated in the second tally. Nevertheless, it seems to the writer that the simple tally sheet proposed above for the first tally would involve decidedly less labor for the tally and count than the program outlined for the Seaton device. And I am sure that there is no materially simpler or easier plan for using the Seaton device in tallying; and equally sure that any small tally sheet designed by those in charge of the 1880 census, with their current experience in large-scale tallying, would have been quite as efficient as the one presented above.

An early evaluation.—In a letter dated February 15, 1872, addressed to the Secretary of the Interior, Francis A. Walker, Superintendent of the Census for 1870 and a part of 1880, reported that he had tested the Seaton device by comparing its efficiency with that of the "normal spread-sheet" method. By the traditional method, he said, a clerk could complete less than 29 pages of tabulation per day, presumably pages of the 1870 population schedule, which was similar in form to that of 1880 but briefer. With the Seaton device, the same clerk could complete 124 pages per day, or more than four times as much.[10]

An analysis of the two processes makes it difficult to believe, with all due respect for General Walker, that there could have been so great a difference in the daily product as between the tally sheet and the Seaton device set up for tallying. Since the process of finding, on the schedule, the classification of the individual (color, sex, and nativity, for the first tally) would be the same for either method, and the physical effort of

[10] Letter quoted in *National Archives Acquisitions*, No. 54, June 1958, p. 25.

Digitized by Google

making the tally also the same, the sole difference would be in the time required to find the tally spot. This would not seem to represent at most more than one-third of the total time per tally, so that the reduction of this time even to zero would leave the Seaton time still two-thirds of the tally sheet time, rather than less than one-quarter.

Or, to look at the problem in another way. The 1870 schedule pages each contained 40 lines, representing 40 individuals to be tallied. Figuring exactly on a 7-hour day, this would give 2.8 tallies per minute, or about 22 seconds per tally, for the tally sheet, as against 11.8 per minute, or about 5 seconds per tally, for the Seaton device. The latter rate seems much more like a reasonable, though rather favorable, rate for an experienced clerk, even with a tally sheet; and the assumption that a clerk would need anything like 22 seconds for a tally seems quite unreasonable,[11] especially in the pre-labor-union period of 1870. One feels inclined to query, then, the record quoted for pre-Seaton tallying, rather than the record of the clerk using the Seaton device.

These comments have been made as relating to work on the first tally, with its small and simple tally sheet—partly because both this tally sheet and the equivalent setup for the Seaton device have been outlined in detail on nearby pages. Some of the later tallies required much larger sheets, some perhaps justifying the term "spread-sheet." But the corresponding layout for the Seaton device would also have been much more complicated, calling for splitting each of the Seaton columns into small sections and putting the tally mark in one or another of a considerable number of such sections.

A further example.—Since the second tally (single years of age, with its requirement of 600 tally spots) was so extremely complex, it might be worth while, in justice to the Seaton device, to consider how it might have been used for one of the less extensive counts, say the sixth count (illiteracy). For this count, with its 36 tally spots, one might assign six of the rollers, used as columns, to the six color-nativity classes; then divide each column into six sections, three for the three age groups with returns of No–No, and three for the same age groups with returns of Yes–No, following the general pattern of tally sheet No. 6 as outlined above. The division of the columns might be made by previously ruled lines running the whole length of the paper strip and thus cutting across the columns presented on the face of the rollers. There might be a heavy line between the third and fourth sections to separate the No–No's from the Yes–No's, with lighter lines above and below to divide the columns into spaces proportionate to the expected numbers of tallies for the several age groups. In the margins of the device, across the tops of the roller-columns, would be designations for the color-nativity

[11] See note on recent tallying experiment on page 42, below. In this experiment an inexperienced tallier tallied and counted 6.2 persons per minute.

Digitized by Google

classes, and down the left-hand edge designations for the age groups. The tally clerk would then find, in the margins of the Seaton device, labels for tally spots similar to those on the proposed tally sheet, though not quite so conveniently arranged.

The ED number, county and State, would be written vertically on the first roller, at the start, then the roller advanced just enough to make room for the tally marks. Since there would be tally marks only for the illiterate, many ED's would require no more than 2 or 3 columns; and one section of the paper roll might well contain the tallies for all the ED's in a large county.

But none of the other tallies calls for so few as 36 tally spots; and the problem of arranging convenient labels for each section of a roller comprising a tally spot becomes increasingly difficult with the increase in the number of tally spots to be accommodated.

Seaton device used for consolidations.—The Seaton device was presumably used also for the consolidation of ED counts into counties or larger areas, though the advantage of having the entry spots close together is far less evident in this case, since the ED figures were already arranged in groups or classes. And for the consolidation of complicated counts, like the second tally, the Seaton sheets would have to be made in a considerable number of sections, often with hurriedly written identification marks; so that the difficulty of getting these sections properly assembled would go far to offset any advantages over a large consolidation sheet like that proposed above.

CARDS AND CHIPS

Perhaps because, even with the help of the Seaton device, the work of tabulating the population census returns by tallying appeared to be unduly burdensome and time-consuming, serious attention was given to the search for other possible methods of tabulation. One new method involved a complete transcription of all the data to be used in the tabulation onto cards, one for each person reported. These cards were then sorted into the various classifications and cross-classifications and counted.

The so-called chip system, devised by Charles F. Pidgin, was a modification of this method in which were used specially designed cards (called chips), printed in different colors and with other features to facilitate both transcription and sorting and counting. This method was used in the 1885 census of Massachusetts. The results of this census, covering only the one State of Massachusetts, were published in two volumes comprising more than 2,000 pages, and presenting the data perhaps in greater detail than any other census in census history (unless it be the 1895 census of Massachusetts). Mr. Pidgin was "First Clerk," in charge of this census, and William C. Hunt (later for so long in

Digitized by Google

charge of the population work in the U.S. Census Office) was "Second Clerk," in charge of tabulation. Both of these men were employed on the Federal Census of 1890.

It may be noted that the card or chip method embodied one of the fundamental elements of later tabulation systems, namely, the assembling of all the required data for an individual on one card (or in one physical unit), which could be manipulated, in connection with other similar units, to produce the desired results. It required much more time, of course, to transcribe to these cards the whole range of census data than to make one of the traditional tallies. But once the cards were made, no further handling of the schedules was required; and the cards could be arranged and counted in many different combinations, so that the time and labor required for the entire program might be materially less, even with the handwritten cards or chips, which required visual sorting and rather laborious counting. In particular, certain basic sorts, like that by color, sex, and nativity, need be made only once, and could be retained for use in connection with consecutive sorts providing different additional details such as age, either in single years or in broad groups, place of birth, or occupation. Under the tally system, on the other hand, these basic classifications had to be built up again and again by repeated observation of the schedule entries.

The written card system thus embodied some of the advantages of the punch card system. To these the substitution of a punched card for a written card was to add three further advantages: (1) A mechanically controlled method of counting; (2) the possibility of counting several items with a single handling of the cards; and (3) a mechanical method of sorting, though that was not too efficient for extensive use, prior to the development of the automatic electric sorter, in 1902.

It may be noted that the written card system of tabulation was actually used in the tabulation of the 700,000 deaths reported in the census of 1880 and even in 1890 for the population of the Territory of Alaska, with its rather small population and somewhat different classifications, for which it presumably did not seem worth while to set up special procedures for the Hollerith machines.

Digitized by Google

Chapter II. THE TWO MEN WHO ORIGINATED THE PUNCH CARD SYSTEM

HERMAN HOLLERITH (1860–1929)

Among the special agents who had charge of various parts of the work on the census of 1880 was Herman Hollerith, whose inventive genius was later to contribute so much, first, to the simplification of the work of tabulating the census data through the transfer of much of the detail of classification and counting to machines, and second, through this mechanization of the burdensome labor of assembling and cross-classifying the initial data, to make practicable far more detailed tabulations of the wealth of significant information recorded on the census schedules.



FIGURE 7.—Herman Hollerith in 1904 (age 44)

Herman Hollerith was born in Buffalo, N.Y., on February 29, 1860, and graduated from the School of Mines, Columbia University, in 1879, at the age of 19. Shortly after graduation he found employment in the Census Office set up for the 1880 census, working in some fashion under the supervision of his recent teacher (in Columbia), Professor William T. Trowbridge, who was an "expert special agent" in charge of statistics of power and machinery used in manufactures. In the published report

Digitized by Google

on power used in manufactures,[1] however, it is Herman Hollerith himself who is credited with the report and who signs the Letter of Transmittal.

In 1890 he received the degree of Ph.D. from the Columbia School of Mines, under somewhat special conditions, in that he was granted permission to pursue the required course of study *away* from the School. For his dissertation he submitted a paper on the Electric Tabulating System.[2]

According to official records, Mr. Hollerith was in the employ of the Census Office from October 20, 1879, to August 30, 1883, when he was transferred to the Patent Office, from which he resigned on March 31, 1884.[3]

It is reported in the *Dictionary of American Biography* (Vol. 21, page 415) that he went to the Massachusetts Institute of Technology in 1882 as an instructor in mechanical engineering and that after a year, not liking teaching, he went to St. Louis to engage in experimental work.

The first part of this statement is verified by a recent letter from the Massachusetts Institute of Technology, which states that he was on the teaching staff there during the academic year 1882–1883. We must assume, then, that he took leave from his Government position for about the time from September, 1882, to June, 1883, and that he then returned to Washington—and perhaps started negotiations for the transfer to the Patent Office.

He resigned from the Patent Office at the end of March 1884, and presumably devoted himself at once to the problem of devising a practicable machine for tabulating population statistics, putting in his first application for a patent on such a machine on September 23, 1884. There would seem to have been no time, then, for any extensive activity in St. Louis. As a result of this and later applications, three patents for tabulating machines were issued, all bearing the date January 8, 1889. These were numbered, in reverse order so far as concerns the stage of development which they represented, 395,781, 395,782, and 395,783. The two last mentioned (initial application, September 23, 1884) carried identical drawings and generally equivalent descriptive material. Patent No. 395,781 (initial application, June 8, 1887), however, presented

---

[1] "Power Used in Manufactures," a 12-page monograph forming a part of the *Report on Manufactures for the United States at the Time of the Tenth Census (1880)*, 1883.

[2] Letter from the registrar of Columbia University, dated August 27, 1964.

[3] In detail, his official record in Government service is as follows:

Census Office
- October 20, 1879, appointed special agent at $600 per annum.
- January 11, 1881, promoted to special agent at $900 per annum.
- August 30, 1883, transferred to Patent Office at $1,200 per annum.

Patent Office
- September 4, 1883, appointed first-class clerk at $1,200 per annum.
- March 31, 1884, resigned.

Digitized by Google

several new features, more closely approximating the system actually used in 1890.

DR. JOHN SHAW BILLINGS (1838–1913)

A far more important member of the professional staff of the Census Office in 1880 was Dr. John Shaw Billings, whose connection with the census resulted from what might be termed a chance assignment 10 years earlier.

In a letter dated October 27, 1870, Francis A. Walker, then Director of the Census, asked the Surgeon General of the Army (Major General Joseph K. Barnes) for assistance in determining the classification of diseases (causes of death) in the 1870 statistics of mortality. For this



FIGURE 8.—Dr. John Shaw Billings in 1908 (age 70)

task the Surgeon General assigned Assistant Surgeons J. J. Woodward and John Shaw Billings. These men made a very careful and intensive study of the situation, with frequent conferences with General Walker, and made a report on February 28, 1872, which included the following recommendations:

1. That with regard to the classification of diseases . . . the tabular form should conform in all essential particulars with the nomenclature and classification published by the Royal College of Physicians of London, in 1869.

2. That figures should be presented for individual States, rather than for groups of States as in 1860.

3. That the record of deaths should be published by months, rather than by quarters.

Digitized by Google

Dr. Billings continued his interest in the vital statistics of the census and by 1880 had become, in effect, an important member of the Census Office staff, though never on the census payroll (except for a short period after his retirement from the Army in 1895).

He had charge of the planning of the work on vital statistics in 1880 and 1890, supervised the work of collecting and tabulating the data, and wrote pages and pages of excellent explanatory and interpretative text for the reports. In this connection he contributed greatly to improvement in the methods of collecting statistics of deaths, gradually increasing the extent to which the data were obtained from local registrations and from special reports by physicians, rather than from the census enumeration, which latter had been shown to be far short of completeness.[4]

Then, as a supplement to the Vital Statistics Reports of 1900, he prepared a special bulletin in which he discussed the general problem confronting any person seeking information in the field of vital statistics, with comments on the state of available statistics and optimistic suggestions as to their use. This text was followed by selected tables and analysis of significant relationships.[5]

Officially, Dr. Billings was, in 1880, Surgeon in the Army, with rank of Major (promoted to Deputy Surgeon General in 1894) and primarily engaged in classifying, indexing, and expanding the Surgeon General's library of medical publications. He found time, however, for many other activities in the field of medicine and related subjects, in addition to his work for the Census.

In 1876, Dr. Billings, with the consent of Surgeon General Barnes, was appointed Medical Advisor to the trustees of the Johns Hopkins Fund and for several years devoted much time not only to the planning of the proposed Johns Hopkins Hospital, but to the improvement of medical training, to the subject of hospital construction, and to public health matters in general.

Again by permission of the Surgeon General, he began, in 1891, to lecture on the subject of hygiene and vital statistics in the University of Pennsylvania. He was also director of the University Hospital; and upon his retirement from the Army in 1895, he became full Professor of Hygiene.

[4] The following tribute to the value of Dr. Billings' service to the Census Office is taken from the general Letter of Transmittal for the 1880 report on Mortality and Vital Statistics, signed by James H. Wardle, Chief of the Census Division:

"Too much cannot be said in recognition of the great advantage which the census work has derived from the services of Dr. Billings. While, within his own corps, he has been building a monument to his learning and industry in the preparation of the colossal Index Catalogue of Medical Literature, he has projected the entire scheme for the compilation of the Mortuary Statistics of the Census, has supervised the work in all stages of its progress, and has subjected the results of these vast tabulations to a discriminating analysis and discussion." *Tenth Census of the United States, 1880*, Vol. XI, *Mortality and Vital Statistics*, Pt. I, p. v.

[5] *A Discussion of the Vital Statistics of the 1900 Census*, by Dr. John Shaw Billings, 1904.

Digitized by Google

On June 1, 1896, Dr. Billings resigned his professorship in the University of Pennsylvania to devote the remainder of his active life to the organization and development of the New York Public Library.

He was a prolific writer on medical and related subjects; an available list of his publications ends with No. 171, an article on the New York Public Library, published in 1911, two years before his death.[6]

RELATIONS BETWEEN MR. HOLLERITH AND DR. BILLINGS

Mr. Hollerith, while in the Census Office in 1880–1881, was also interested in vital statistics, as witness the fact that in the Letter of Transmittal for the 1880 report on *Mortality and Vital Statistics*, Dr. Billings included the following sentence: "I am also indebted to Mr. Herman Hollerith for valuable assistance in the compilation of the life tables and diagrams illustrating them." These two men doubtless often discussed the problems of tabulation; and the earliest work done by the new Hollerith tabulating machine was done in the field of vital statistics —first in the city of Baltimore (in 1887), then in the State Health Office of New Jersey, and to a limited extent in the city of New York. Machines were also installed in 1889 in the Office of the Surgeon General of the Army, for work on Army morbidity records.

There are extant several differing accounts of the contribution of Dr. Billings to the development of the Hollerith punch card system. The most frequent version is that Dr. Billings at some time said to Hollerith something like "There ought to be a machine for doing the purely mechanical work of tabulating population and similar statistics." This remark is variously placed; sometimes in the midst of a discussion in the Census Office, or sometimes at Dr. Billings' tea table, on a Sunday afternoon.

With respect to the different reports of this event which may be found in the literature, however, the most satisfactory is perhaps this, from an article by the late Dr. Walter F. Willcox, whose employment in the Census Office during the 1900 census period gave him opportunity for direct contacts with Mr. Hollerith. The article was published in 1926, though it appears, in substance, in an unpublished manuscript written in 1914. It reads as follows:

> While the returns of the Tenth (1880) Census were being tabulated at Washington, Billings was walking with a companion through the office in which hundreds of clerks were engaged in laboriously transferring items of information from the schedules to the record sheets by the slow and heartbreaking method of hand tallying. As they were watching the clerks he said to his companion, "There ought to be some mechanical

[6] F. H. Garrison, *John Shaw Billings: A Memoir*, G. P. Putnam's Sons, New York, 1915. This is a most excellent biography, except that it devotes only a few stray lines to Dr. Billings' extensive service for the census.

Digitized by Google

way of doing this job, something on the principle of the Jacquard loom,[7] whereby holes in a card regulate the pattern to be woven." The seed fell on good ground. His companion was a talented young engineer in the office who first convinced himself that the idea was practicable and then that Billings had no desire to claim or use it.

Then Professor Willcox continues, in a footnote:

This statement is based on my memory of a conversation with Mr. Hollerith. I have since received a letter from the daughter of Dr. Billings, Mrs. K. B. Wilson, in which she writes "I do not remember hearing of Father's remarks to Herman Hollerith about these machines [the Jacquard loom] being applied to census tabulations, but I do remember the first little wooden model which Herman Hollerith brought to our library many evenings while they were puzzling their brains over its adaptation."

In a recent conversation[8] Professor Willcox expressed the opinion that Hollerith may have made himself somewhat of a nuisance to Dr. Billings—an opinion which is supported by references to conversations "at Dr. Billings' tea table," and to the "little wooden model" brought to the Billings library for discussion.

Significant also as representing recollections from Hollerith's own point of view is the following, taken from a letter of his dated August 7, 1919:

One Sunday evening, at Dr. Billings' tea table, he said to me there ought to be a machine for doing the purely mechanical work of tabulating population and similar statistics. We talked the matter over and I remember . . . he thought of using cards with the description of the individual shown by notches punched in the edge of the card. . . . After studying the problem I went back to Dr. Billings and said that I thought I could work out a solution for the problem and asked him would he go in with me. The Doctor said he was not interested any further than to see some solution of the problem worked out.[9]

Actually, Dr. Billings' suggestions were even more specific, as indicated by the following paragraphs quoted from the abstract of a paper, entitled "Mechanical Methods Used in Compiling Data of the Eleventh U.S. Census, with Exhibition of a Machine," which was presented by Dr. Billings at the 40th meeting of the American Association for the Advancement of Science in Washington in August, 1891.

That the data collected by the census for each living person, or, in systems of death registration, for each decedent, might be recorded on a single card or slip by punching small holes in different parts of it, and that these cards might then be assorted and counted by mechanical means according to any selected groupings of these perforations, *was first suggested by Dr. Billings in 1880.* [Italics added.]

---

[7] No reference is made in any of the available early (pre-1890) records to the Jacquard loom as a precedent for the use of punched cards in the operation of machinery; but in a lecture given at the University of Pennsylvania in 1896, as recorded in a paper on file in the New York Public Library, Dr. Billings said "My original idea was to use a punched slip of paper as a guide to rods and labors [levers?], which would operate on the principle of the Jacquard loom, but Mr. Hollerith has made use of the power of electricity." This indicates that Dr. Billings not only had in mind the general problem of machine tabulation (what it should do), but had given some thought to the mechanics of a possible solution.

[8] Reported to the writer by James L. McPherson.

[9] Quoted in *The New England Journal of Medicine*, April 4, 1963, p. 779. Note, incidentally, that this letter embodies the "tea table" version of the initial suggestion from Dr. Billings.

Digitized by Google

This suggestion was taken up by Mr. Herman Hollerith, and by him has been elaborated into practical shape in the system which is now in use in the Population and Vital Statistics Divisions of the Eleventh U.S. Census, and which has been adopted for the compilation work of the recent Austrian and Canadian censuses.[10]

These paragraphs were followed by a brief explanation of the operation of the machine, as used in the tabulation of the 1890 census of population, including reference to the sorting box. The fact that the presentation of this paper was accompanied by a machine for demonstration of the Hollerith system affords full evidence of a close cooperation between Dr. Billings and Mr. Hollerith at this period.

In fact, Dr. Billings had written much earlier, in 1887, with respect to the use of the Hollerith machine in connection with the tabulation of vital statistics in a paper entitled "On Some Forms of Tables of Vital Statistics."[11] In this paper, he reproduces the actual form of the punch cards being used in Baltimore and New Jersey, together with a form Hollerith was proposing for use in the city of New York; all three were of the general edge-punched pattern of the card illustrated in figure 10. Accompanying the card proposed for New York was a complete set of instructions for punching (with an ordinary conductor's punch) and for the general handling of the cards.

In this paper (page 205) Dr. Billings says, of the Hollerith tabulating machine:

> I have watched with great interest the progress in developing and perfecting this machine, because seven years ago [in 1880] I became satisfied that some such system was possible and desirable, and advised Mr. Hollerith who was then engaged on census work, to take the matter up and devise such a machine as is needed for counting various combinations of large numbers of data, as in census work or in vital statistics. I think that he has succeeded, and that compilers of demographical data will be glad to know of this system.

Still earlier, on the last page of the text of the 1880 report on Mortality and Vital Statistics, published in 1885 (but probably written earlier, possibly before Hollerith had filed his first application for a patent on his first-designed tabulating machine), Dr. Billings made these recommendations:

> Where the data of State or municipal registrations of deaths are to be copied for the use of the census, the copies should be made on cards . . .
>
> It would also be quite possible to record many of the data on such cards by punching slots or holes in them in such a way that the several enumerations required could be made by electrical counting or by distributing the cards by machinery, thus insuring accuracy as well as speed.[12]

---

[10] *Proceedings of the American Association for the Advancement of Science*, for the 40th meeting, held in Washington, 1891; Salem, 1892, p. 407.

[11] John Shaw Billings, "On Some Forms of Tables of Vital Statistics, With Special Reference to the Needs of the Health Department of a City," *Public Health Papers and Reports*, American Public Health Association, Vol. XIII, 1887, pp. 203-221.

[12] *Tenth Census of the United States, 1880*, Vol. XII, Mortality and Vital Statistics, Pt. II, p. clviii.

Digitized by Google

And in a paper presented at the Thirteenth Annual Meeting of the American Public Health Association, in December, 1885, Dr. Billings summarizes the current methods of tabulating mortality statistics and again presents the proposal to use punched cards, as follows:

> The method most commonly used in this country is to take some form of a tally sheet for each unit of area, and on this tally to mark in the space reserved for this purpose, either with a pencil stroke or [with] the prick of a pin, the number of cases which come under that particular head. Such tally sheets, however, if made to include a large number of items, are large and clumsy, and give rise to great liability of error in getting the tally into the wrong square or space. Instead of spreading the tally squares over one large sheet, a much more convenient form is to use a number of small cards, each relating to a single form of disease, and forming a bundle of cards or slips for each unit of area. *This was the method used in compiling the data for the 700,000 deaths reported in the last* [1880] *census.* [Italics added.]
>
> Practical experience has thus shown that the most rapid and accurate compilation is to be secured by the use of small cards, each of which is devoted to the data relating to an individual. . . . Packets of cards thus prepared can be rapidly distributed by localities, color, sex, age, etc., and then counted . . . The best way, probably, is to record the data by punching out pieces . . . in various parts of the cards and by distinctions in color in the cards themselves. It would be quite possible to have the punching of these cards done by machinery, by simply playing upon keys like those of a piano or a writing machine, and after the cards had been punched, to have them distributed in various ways, and counted by machinery or by electricity. In fact, a method for doing this last has already been devised, and seems to work very well.[13]

The late Dr. Raymond Pearl, of Johns Hopkins, after consideration of material like that quoted above, was persuaded that the major credit in the development of the method of tabulating statistics through the use of punched cards should go to Dr. Billings, as witness the following from a paper published in 1938:

> In all essentials the case seems clear. Billings was the originator, the *discoverer*, who contributed that which lies at the core of every scientific discovery, namely, an original idea that proved in the trial to be sound and good; Hollerith built a machine that implemented the idea to practical performance, the accomplishment here, as always, of the successful *inventor*.[14]

One further point might be made, by way of supplement to Dr. Pearl's analysis of the respective contributions of these two men to the development of the punch card system which was used first for vital statistics in Baltimore (1887) and elsewhere, and in the Office of the Surgeon General of the Army (1889), prior to its major demonstration in the 1890 census. It seems more than likely, in view of his persistent

---

[13] John S. Billings, "Methods of Tabulating and Publishing Records of Death," *American Public Health Association, Papers and Reports*, Vol. XI, Concord, N.H., 1886 (Reports of the 13th Annual Meeting, held in Washington, December 1885), p. 55.

[14] Raymond Pearl, "Some Notes on the Contributions of Dr. John Shaw Billings to the Development of Vital Statistics," in *Bulletin of the Institute of the History of Medicine*, Vol. VI, No. 5, May, 1938, p. 391.

Digitized by Google

efforts in other fields (also supplementary to his major interest in the Surgeon General's Library, the *Index-Catalogue*, and the *Index Medicus*), that Dr. Billings would have sought other assistance in putting his idea into tangible form if Hollerith had not undertaken the task, while it seems probable that, without stimulus from Dr. Billings, Hollerith might well have devoted his energies to other fields in which he was interested.[15]

[15] During the period shortly following his employment in the Census Office, Hollerith had secured patents on electrically operated railroad switches, air brakes for railroad cars, an apparatus for corrugating metal tubing, and perhaps others.

Digitized by Google

Chapter III. THE HOLLERITH TABULATING SYSTEM

The basic principle.—The basic theory underlying the Hollerith system of tabulation was to represent the various characteristics of the population or other items required to be counted, by holes punched in cards or strips of paper in specified locations, and then to count the holes in each location through electrical contacts.

For a specific reference, note the following from a paper read by Mr. Hollerith before the Royal Statistical Society in London, December 4, 1894:

> The system of electrical tabulation may perhaps be most readily described as the mechanical equivalent of the well-known method of compiling statistics by means of individual cards, upon which the characteristics are indicated by writing. As it would be difficult to construct a machine to read such written cards, I prepare cards by punching holes in them, the relative positions of such holes describing the individual.[1]

Once the cards were punched, it was noted, the positioned holes served not only to direct the count to the proper register on the tabulating machine but also to direct the card to the proper pocket in a sorting box operated in conjunction with the tabulating machine. They also simplified hand sorting, of which there was much to be done prior to the introduction of the electric sorting machine, late in the 1900 census period, since groups of cards with the same punched symbol could be picked out by sighting through the significant hole or through the use of the sorting needle (an old-fashioned steel knitting needle). This advantage was especially manifest when there were large numbers of cards with the same characteristic—for example, white, in the color classification of the population in a northern area.

Hollerith's first tabulating machine.—Hollerith's first design for a tabulating machine was for a machine which would use a continuous roll of paper, rather than a series of cards. This machine was eventually covered by Patent No. 395,783; first application, September 23, 1884; its essential features are shown in the accompanying drawing, reproduced from the patent as figure 9.

As applied to the census or to vital statistics, the items to be counted would be represented by a double row of holes punched across the width

[1] *Journal of the Royal Statistical Society*, Vol. 57, Pt. 4, December 1894, p. 678. An interesting (and probably apochryphal) anecdote often quoted in this connection is represented by this excerpt from a recent (1919) letter of Hollerith's: "One thing that helped me along in this matter was that some time before I was travelling in the west and I had a ticket with what I think was called a punch photograph. When the ticket was first presented to a conductor he punched out the description of the individual, as light hair, dark eyes, large nose, etc. So you see I only made a punch photograph of each person."

758-612 O - 65 - 4

Digitized by Google

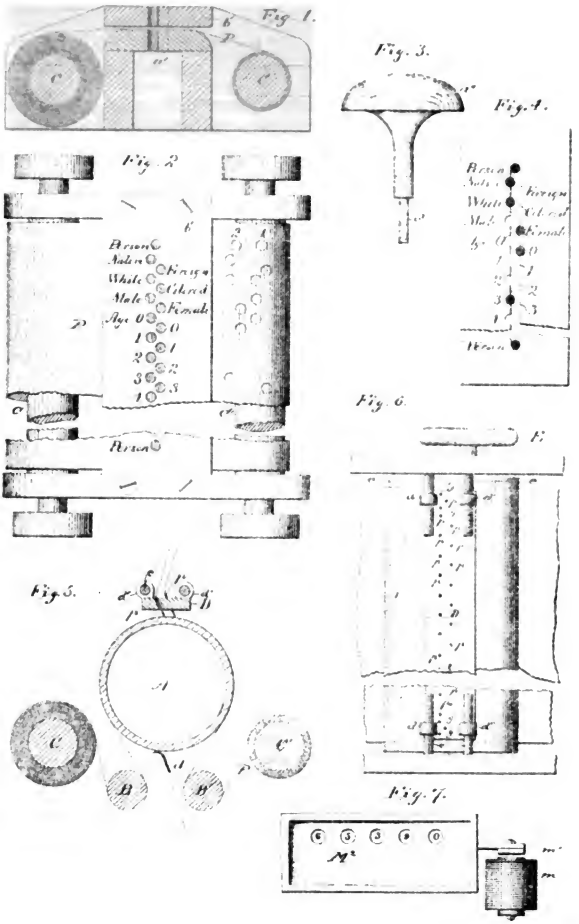


FIGURE 9.—Hollerith's first tabulating machine. Drawings reproduced from Patent No. 395,783

Digitized by Google

of the paper through the use of a rather primitive hand punch. The blank paper was to be fed across from one roller to another, running under a metal template with a hole in each punch-position through which a hand punch was to be pushed to provide the record. The punched roll of paper was then run across a metallic cylinder under a long series of electrical contact brushes connected with counters which registered for each position a count of the number of holes punched in this position. The counters used in this invention showed a series of digits (see "Fig. 7" on the drawing) and were easier to read than the clockface counters actually used in 1890 and 1900, though the latter were simpler, from a mechanical point of view, and doubtless easier to keep in order.

The systems of relays incorporated in this early machine, for counting items represented by two or more punched holes, were essentially the same as those used in the later punched card machine.

The method of operation of Hollerith's first designed machine for tabulating census statistics, as illustrated in figure 9, is explained in the following paragraphs, quoted from the text of Patent No. 395,783:

The transcription of the returns to the sheets of electrical non-conducting material can be made in various ways. I prefer to use a strip of paper, P, which is passed from one roller to another over a die-plate as shown in Figs. 1 and 2. The die-plate a' is provided with a series of holes, placed staggering, extending across the width of the paper strip, as shown in plan in Fig. 2. Above the die-plate a' is the guide-plate b', provided with holes corresponding to the holes in the die-plate a'. With a tool consisting of a plain punch, . . . as shown in Fig. 3, holes can be punched in the strip of paper in suitable relative positions according to the holes in the guide-plate b' and die-plate a'. The holes are suitably lettered or numbered on the guide-plate b', as shown in Fig. 2. At the extreme end is a hole marked "person," separate somewhat from the remainder, the object of which will hereinafter be more fully explained. The paper strip is drawn to a certain position when the various statistical items for a given person are recorded by punching suitable holes in a line across the strip, being guided by letters on the guide-plate. A hole is thus punched corresponding to "person"; then a hole according as person is a male or female; another recording whether native or foreign-born; another, either white or colored, etc. . . . When the various statistical items relating to one person have been thus recorded or transcribed, the paper strip, P, is drawn forward and the items or data relating to the next person are recorded, any suitable system of notation being used to identify each transcription.

When the various items have been thus transcribed, it may be desirable or necessary to verify, entirely or in part, the accuracy of such transcription. For this purpose a scale of card-board, thin metal, or other suitable material may be used, arranged as shown in Fig. 4, it being lettered and numbered corresponding with the guide-plate of punching apparatus. This scale is placed across the paper strip, being located in postion by the holes marked "person" at each end. The transcription for the given person can thus be read according to the location of the holes. Any errors can now be corrected by punching holes in proper places and covering all holes wrongly punched by small seals of paper or other suitable electrically non-conducting material.

When the transcription for a certain district has been made and verified, as above described, the strip is passed through a counting-machine, in which the separate items

Digitized by Google

or combination of items are counted or tallied. This counting-machine can be constructed in various ways. The construction which I prefer consists, essentially, of a metallic drum or cylinder, A, Fig. 5, over which the strip of paper, P, is passed from a roller, C, to a roller C′, around suitable guide-rollers, B B′. . . . Passing through the bar D, and suitably insulated from each other, are the metallic pins or pointers *p*. These pins are arranged in relative positions corresponding to the centers of the holes in the die-plate *a′*, Fig. 1. The pointers or pins *p* press against the drum A, and, together with the drum A and metallic brush *d*, can each be made part of an electric circuit. In an electric circuit with each pointer can be placed an electro-magnet, *m*, Fig. 7, the armature *m′* of which is attached to a lever operating any suitable mechanical counter—such, for example, as are used for registering the revolutions of a steam-engine—as shown at M^3 in Fig. 7. If the paper is now drawn through the counting-machine, the circuit through any given point *p* is closed and broken each time a hole in the paper strip passes under the pointer, the armature of the magnet being attracted when the circuit is closed and withdrawn by the spring when the circuit is broken, thus registering one for each hole.

This patent contained a statement (doubtless added at a date subsequent to the first submission of the application) to the effect that holes punched in separate cards or sheets of nonconducting material might be used in place of the continuous roll, and that in such case a reciprocating device would be used for feeding them into the tabulating machine. But the details of construction and operation were given only for the device using the continuous roll.

The machine proposed for the 1890 census.—The machine actually used in the 1890 census is described in Patent No. 395,781, first application filed June 8, 1887. For this machine the data were recorded on manila cards, using one card for each unit of the tabulation.

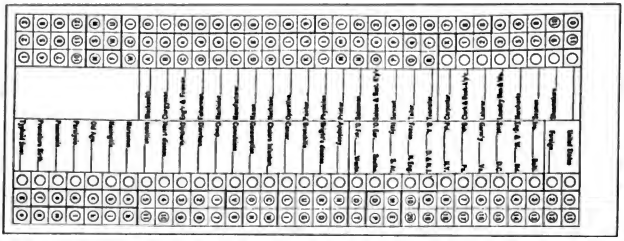


FIGURE 10.—Card for Baltimore vital statistics, 1887

The early cards.—The earliest card of which we have specific record was used, in 1887, for the tabulation of vital statistics in the city of Baltimore. This card was 3¼ inches deep and 8⅝ inches long, with

Digitized by Google

three rows of 32 punch positions across the top of the card and three rows across the bottom. These early cards were punched with a modified ticket punch, and to facilitate this process the punch positions were set near the edge of the card, as illustrated in figure 10.

Two other cards for vital statistics, one for New Jersey and one for New York City, were set up in similar form prior to 1890. The face of these cards was printed, to show the location of the punch positions representing the various items to be counted.

The card planned for the census was shorter, 6⅝ by 3¼, with punch positions occupying the whole surface of the card. The 1890 census cards were not printed, though they had one corner clipped, to aid in keeping them in proper position. Strictly, since the assignment of each punch position was indicated on the face plate of the pantograph punch, the printing of the cards was not necessary; but experience seemed to show that the difficulty in reading the blank (unprinted) cards was a serious disadvantage. At any rate, all subsequent census cards were printed.

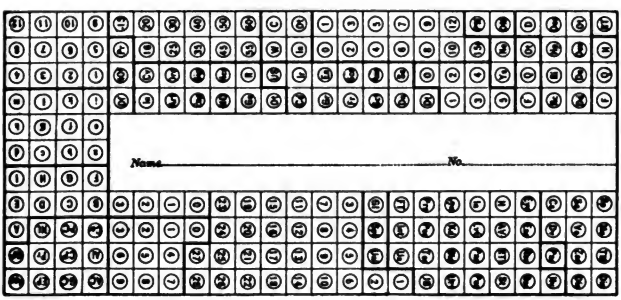


FIGURE 11.—Card for Surgeon General's Office, 1889

Intermediate between the early vital statistics cards and the census card was a card designed for use in the Office of the Surgeon General of the Army, beginning January 1889. This card, which is illustrated in figure 11, was approximately the same size as the census card, but had the punch positions arranged in rows around three sides, so as to have permitted the use of the ticket punch; and for some reason the form was only 11 positions deep, rather than 12. Perhaps this was in view of the possibility of using the early numerical key punch, which had only 11 keys (see figure 30). It is stated, however, in a monograph published

Digitized by Google

in 1958 by the Office of the Surgeon General of the Army that the cards were punched on the pantograph punch (see below), which piece of equipment is illustrated in the monograph, along with other items in the Hollerith system.[2]

The text of Patent No. 395,781 enumerates some of the advantages of the separate card, as compared with the continuous roll, including the fact that the cards could be prepared at different times, by unskilled operatives, and then assembled for tabulation (an advantage appearing in vital statistics work, rather than in census work), that occasional errors could be more conveniently corrected, and, most important, that the cards could be readily "sorted" for tabulations requiring extensive cross-classifications. This last, it may be noted, was one of the advantages possessed by the card or chip system, described above, in comparison with earlier tally systems—as likewise the fact that the transcription of the original returns was made only once, for perhaps a long series of tabulations.

Further details are given below, in the form of a description of the machines actually used in the 1890 census.

Before the Hollerith system was considered ready for the 1890 census, two more radical changes were made. The entire face of the card was divided into 24 columns of quarter-inch squares, 288 in all, of which 4 columns at the left were reserved for geographic identification. And an entirely new machine was designed for punching the cards—two new machines, in fact, one for the 240 spaces comprising the body of the card and one, designated the gang punch, since it punched several cards at one time, for the geographic identification section.

So far, Hollerith was working as an independent inventor, with no commitment from the census authorities for the use of his invention, except for such informal understandings as might have grown out of his close association with Dr. Billings, referred to above. It is obvious, however, that he had clearly in mind the requirements for the tabulation of the population census.

The 1889 test.—In compliance with a suggestion made by the Secretary of the Interior in 1889, the Superintendent of the Census, Robert P. Porter, appointed a committee to consider the method of tabulation to be employed in the Eleventh (1890) Census, comprising Dr. John S. Billings, Henry Gannett, Geographer of the Census, and William C.

[2] *Tabulating Equipment and Army Medical Statistics*, by Brig. Gen. Albert G. Love, Col. Eugene L. Hamilton, and Ida Levin Hellman (1958). See especially chapter IV, "Development and Description of Electrical Accounting Machines," pp. 36–51. This chapter is based largely on Hollerith's article in the *School of Mines Quarterly* and Martin's article in the *Electrical Engineer*, both referred to below, but presents specific dates from the records of the Surgeon General's Office.

Digitized by Google

Hunt, later Chief of the Population Division. The two methods at first considered were the Hollerith system and the chip system, proposed by Charles F. Pidgin. Mr. Hunt presently resigned from the committee (his place being taken by L. M. E. Cooke) in order to present, independently, a card or slip system, somewhat different from Pidgin's chip system—presumably simpler, and depending more heavily on the skill of the clerks doing the work.

The report of the committee, dated November 30, 1889, describes the test as follows:

> To test these various methods, four enumeration districts in the city of St. Louis, selected from the re-enumeration of 1880, were selected. These districts contained 10,491 inhabitants. The contestant was required (a) to transfer the information from the schedules to cards or chips; (b) to tabulate this information in the form of a table for the purpose of testing the *rapidity* of the methods; and (c) to tabulate it in the form of extended tables, for the purpose of testing the *capacity* of the methods.

A copy of the headings proposed for the test table was enclosed with the report. This table listed 90 separate items, or more than twice the number of counters on the Hollerith machine and was thus far beyond the capacity of the machine for a single run of the cards; and the time recorded for the tabulation in the test, 5 hours and 28 minutes, was barely enough for one run of the cards through the tabulating machine. In fact, the proposed table was beyond the capacity of even the 60-counter machines used in 1910 or 1920, without sorting and the resulting multiple readings. It may be assumed, then, that the table actually used in the test (possibly approximating in difficulty the first count of 1890 outlined below, which approaches the maximum capacity of the machine) covered only a part of the 90 items listed—the remainder being reserved, perhaps, for section (c), the capacity to produce "extended" tables. But the committee expressed itself satisfied that the Hollerith equipment should be recommended, without waiting even for the final completion of the "rapidity" test of the chip system—the Hollerith method being obviously so far ahead.

Both the Hunt and the Pidgin systems had one fundamental step in common with the Hollerith system, in that they required the transcription of the required data to cards, one for each person—in the form of written symbols (or color codes) on the one hand and of holes punched in designated positions on the cards, on the other. The written cards were then to be sorted into significant groups and counted, while from the punched cards the Hollerith machine counted the required items from the cards as they went through, without presorting.

Looking back on this test, one wonders why the 1880 tally system was not entered in this competition; for it seems likely that, for a single

Digitized by Google

tabulation no more complicated than the first count of 1890, the tally system might have won out.[3]

This does not mean that the card systems represented a step backward, but rather that their tremendous advantages are not manifest in a single tabulation, but consist rather in the fact that, once the data are on sortable cards, including the basic classifications like color, sex, or age which are used time after time in combination with other characteristics, the cards may be sorted into these classes and counted time after time in combination with first one and then another of the minor items, without further reference to the original schedules.

An additional point to be considered in comparing any of the card methods with tallying, is that the more mechanical methods are far less exacting than the work of tallying and can be carried out with a lower grade of clerical help.

The punched card system offers an additional advantage in that the machine counts four or five or six different items, in any desired combination, at one handling, rather than only one item (or two). And for sorting the cards, the punched cards, even if sorted by "hand," offer a great advantage in that large packs of cards carrying the same punched designation can be identified by sighting through, or by the use of the sorting needle; and smaller groups can readily be separated out without handling or visually identifying individual cards.

The records of the test described above were as follows:

Method	Time required					
	To transcribe		To tabulate		Total	
	Hrs.	*Min.*	*Hrs.*	*Min.*	*Hrs.*	*Min.*
Hollerith, punched cards	72	27	5	28	77	55
Pidgin, "chips"	110	56	44	41	155	37
Hunt, slips	144	25	55	22	199	47

It may be noted that even in the transcription the Hollerith system was far ahead of its rivals; that is, the time required for punching the Hollerith cards was far less than the time required for transcription of

[3] This statement is supported by a limited experiment, but one that seems amply to justify the general statement just made. The writer, with less than an hour's experience in tallying, tallied 277 persons (from 1950 schedules, which are much less conveniently arranged for tallying than those of 1880) for 5-year age groups by color, sex, and nativity, together with marital status by age, and counted the tallies, in 45 minutes. This tally was considered practically equal to the first machine count of 1890, and perhaps to the table actually produced in the test. At the same rate, the 10,941 persons of the 1880 test would have been tallied in about 30 hours, or less than one-half the Hollerith record, and tally clerks with even a few days of experience would have made a much better record. Or, even granting that the test table might have required two consecutive tallies, the time would still have been a bit less than the machine time.

Digitized by Google

the same data to handwritten cards. But the greatest advantage was in the tabulation, for which the Hollerith system required only about one-tenth (or one-eighth) of the time of the competing methods. This resulted partly from the fact that the Hollerith system required far less sorting of the cards (practically none, except possibly a sort by sex, which may have been made as a part of the punching operation), and partly from the fact that several counts were made from one physical handling of the cards.

The problem of geographic consolidation.—If one attempts to analyze the whole process required to assemble the data reported by individuals on schedules representing very small areas, into tables for cities, States, and national totals, it becomes evident that a large part of the task is that involved in consolidating the tabulations for small areas into successively larger areas. And with tally sheets or with handwritten cards to be counted by hand, all detail that is to be presented for the very largest areas must be tabulated for the smallest (ED's) and laboriously added, step by step, in a series of geographic consolidation sheets.

With the punched cards, however, the cards can be (and are) consolidated into large geographic groups (packs) for the more complicated tabulations. This is one of the manifest advantages of the punched card system—in addition to the easier sorting (even before the sorting machine) and the multiple counting. After 40 years (in 1930), there came the summary card for consolidation purposes; though for some various reasons its general adoption was delayed for yet another 10 years. But that, as Kipling would say, is another story.

Details of the 1890 System

The keyboard (pantograph) punch.—The development of a satisfactory method for punching the cards apparently came a little later

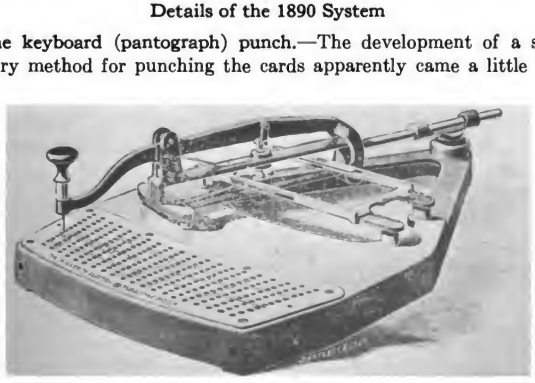


FIGURE 12.—Hollerith's keyboard (pantograph) punch

Digitized by Google

than the development of the machine for counting or tabulating the cards; for in an article written by Hollerith and published in 1889 [4] appears the suggestion "The holes may be punched with any ordinary ticket punch, cutting a round hole 3/16 of an inch in diameter." And the early cards used for tabulating vital statistics, as noted above and illustrated in figure 10, were arranged with rows of holes along the edges for convenience in the use of such a punch.

Well before the work on the 1890 census began, however, Hollerith had developed a much more efficient punch, called, first, the keyboard punch, because an important feature of it was an enlarged keyboard diagram of the card to be punched, which indicated to the operator exactly the position of the hole to be punched. Later (it was still in use as late as 1920) this machine was more often referred to as the pantograph punch, by reason of the pantograph principle employed in its operation. This punch is illustrated in figure 12, with the keyboard in detail in figure 13.

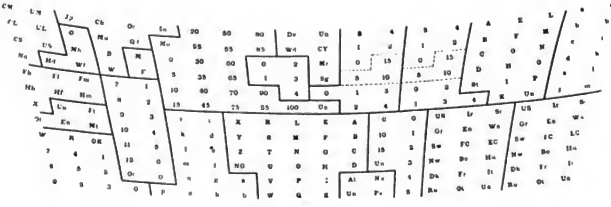


FIGURE 13.—Symbols on "keyboard" of punch

The gang punch.—The geographic area represented by the cards was indicated by a series of code numbers punched in the first four columns of the card through the use of a rather simple machine termed a gang punch. (See illustration, figure 14.) This machine was operated by

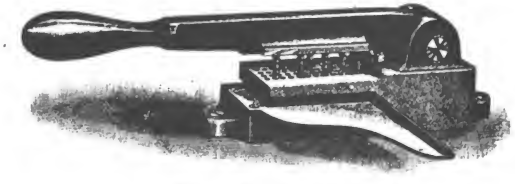


FIGURE 14.—Gang punch

[4] "An Electric Tabulating System," *School of Mines Quarterly* (Columbia), Vol. 10, No. 3, April 1889 p. 245.

Digitized by Google

hand, or sometimes by a foot lever. For a given enumeration district the cutters were set to represent the proper code number; then the cards were taken, four at a time, inserted in the machine, and the lever depressed. And so on until the ED was completed. (This hand-operated machine was used until around 1928.)

The geographic codes were so arranged that certain parts of the area on the card indicated the State, other parts the county and major city, and still others the ED's (enumeration districts) and other county subdivisions. Thus, as the tabulation areas increased in size, from one run to another, successive parts of the gang punch code could be left out of consideration.

The punching operation.—The operation of the pantograph punch, as it was used in the Census Office in 1890, was described by T. C. Martin, a contemporary observer, as follows (quotation slightly condensed and figures renumbered):

> In order to transfer the particulars as to each individual from the 13,000,000 schedules, Mr. Hollerith devised the machine shown in figure 12, known as the "keyboard punch." It is about the size of a typewriter tray, having in front a perforated punch-board of celluloid, translated in figure 13. Over this keyboard swings freely a sharp index finger, whose movement, after the manner of a pantograph, is repeated at the rear by a punch. The movement of the punch is limited between two guides upon which are placed thin manila cards 6⅝ inches long by 3¼ inches high, with the lower corner slightly clipped. The keyboard, as will be observed, has twelve rows of twenty holes, and each hole has its distinctive lettering or number that corresponds to the inquiry and answer respecting every person. Hence when the index finger is pressed down into any one of these holes, the punch at the back says "ditto" by stamping out a hole in the manila card. At first glance, perhaps, the keyboard looks complicated, but it is scientifically grouped, and, as the writer can testify, it is very readily learned. For such inquiries as indicate one of a very few possible classes, sex, for example, the answer is simply "male" or "female," or "M" and "F." So, too, in regard to conjugal relationships, where the answer would be either single, married, widowed or divorced, and one punch suffices for each of these conditions. These holes may easily be found in "Dv," "Wd," "Mr," or "CY," the last of which means that the person was married during the Census Year. Where, however, the answers would cover a wider range of classification, as in age, running from 1 to 100, recourse is had to a combination of two holes, the first indicating a group, as from 25 to 29 years, while the second hole designates the single year in that group. Up in the left-hand corner are double letters that bear upon the status of combatants in the Civil War, while down in the lower right-hand corner are other double letters that tell one's place of birth and the place of birth one one's forebears.
>
> To assist the clerks in memorizing the keyboard for punching, classification lists were used. Thus, "Ka," standing for Germany, stands also for many divisions of the German Empire that a clerk without some such guide might be inclined to hand over again to France, Austria or Denmark. As regards the United States, each Commonwealth is designated by two letters, the first capital letter being the group, such as North Atlantic, while the small letter is the particular State. Thus, Georgia is "Bb," while Connecticut is "Ag." Now to get the run of these combinations is not difficult when once you have started. The larger percentage of all the population of any State is born within its borders, for which the hole marked "St" is provided, or else it is from

Digitized by Google

two or three States near by. It follows, therefore, that, after all, the symbols "come easy" with each lot of schedules. The same remark holds true with regard to occupations. A clerk punching the card for an agricultural district has but few symbols to bother about. In many a New England town "cotton mill operative" will fit most cases. Down the Wyoming Valley of Pennsylvania, coal miners will be apt to predominate; while out in California, fruit growers will be numerous. It will thus be seen that these innocent combinations, which a leading New York newspaper has epitheted as "refinements of torture," are no more burdensome on the memory than the details of a typewriter keyboard.

That the work of punching became as easy as any other task requiring ordinary intelligence is shown in the fact that the estimated average of 500 cards per day per clerk resolved itself very soon into an actual average of 700. It is stated that some of the more expert punchers, working from 9 a.m. to 4 p.m., have done 1,100 cards, with an aggregate of 18,700 holes, each card having 17 holes in it that relate specifically to the individual whose life history is thus condensed.

After the cards leave the punching clerks, they are kept in their enumeration districts, and they have now to be further punched to show the exact locality they belong to. For this purpose the space of about one inch across the left-hand end of the card was left blank, no portion to the left of a fictitious line being punched on the keyboard punch. This space is further divided by imaginary lines into 48 squares, in the combinations of which every enumeration district can be recorded, and it is perforated by means of the "gang punch," shown in figure 14. The combination for any given enumeration district is arranged in this, and then all the cards of that district are passed through. From three to six cards can be punched at a time, hence the name. When this is done, the cards are completed, as shown in figure 15, which is a facsimile, reduced in size, of the card for the head of a family in Chicago.

So familiar do the clerks become with the position of the holes in these cards, they can read them off at a glance. As a means of verifying, however, a "reading board" is provided, the same size as the card, and having also each of the 240 abbreviations in a quarter-inch space, so that when a perforated card is put on this templet the abbreviation will show wherever a hole has been punched.[6]

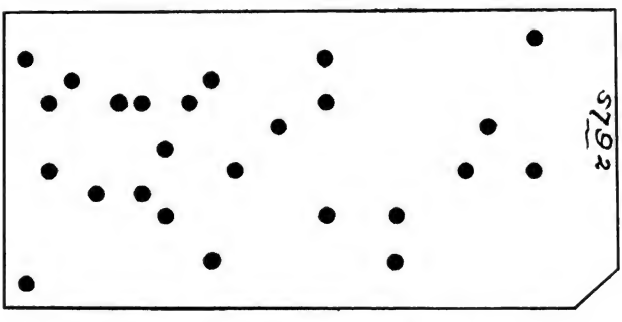


FIGURE 15.—Complete card as punched for 1890

[6] T. C. Martin, "Counting a Nation by Electricity," *Electrical Engineer*, November 11, 1891, pp. 523–524.

Digitized by Google

The 1890 punch cards, as indicated by figure 15, were completely blank except for an identification number running down the right end; but they had the lower right corner clipped, to make it possible to keep the cards in proper position. The printed form of the reading board, however, which is shown in figure 16, represents the way the card would have been printed if it had been printed. Note that the fields (groups of punch positions) on this card run across the top of the card, six positions deep, and then back across the bottom, following somewhat the pattern of the Surgeon General's card, illustrated in figure 11.

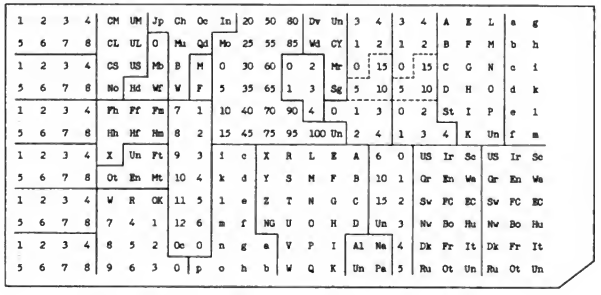


FIGURE 16.—Content of 1890 card (from reading board)

The Tabulating Machine in Detail

The tabulating equipment, as it was set up for operation, with the supplementary sorting box, is illustrated in figure 17.[6] The tabulating machine itself comprised two parts, the press or circuit-closing device, shown in figures 18 and 19, and the counters, shown in detail in figure 20. The press consisted of a hard rubber bed plate, as shown in section in figure 19, provided with guides or stops against which the punched cards were placed, so that the punch positions would come always in exactly the same relation with the rest of the machinery. This hard rubber plate contained holes or cups corresponding in number and position with the 288 quarter-inch squares into which the card was divided for punching. From inside the bottom of each cup a wire extended to a binding post on the back of the supporting framework (see figure 21). Each cup was partly filled with mercury, to facilitate electrical connection, through its wire, with its individual binding post. Above the hard rubber base plate was a reciprocating pin box, provided with projecting, spring-actuated pins, spaced exactly over the centers of the mercury cups. This device with its series of pins was electrically connected as a

[6] An actual machine, of the type used in 1890 and 1900, is on exhibit in the Smithsonian Institution, in Washington, D. C.

Digitized by Google

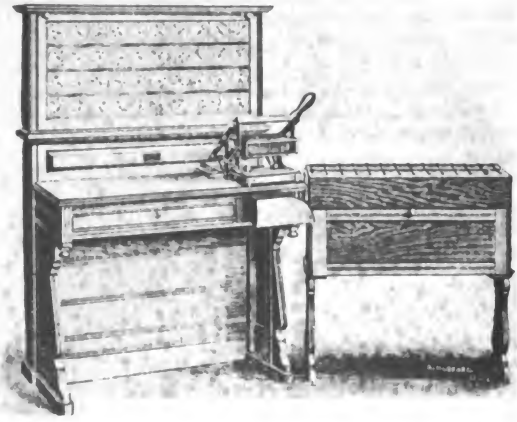


FIGURE 17.—Hollerith electric tabulating machine, with sorting box

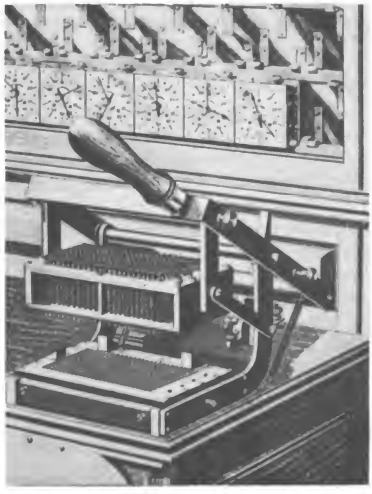


FIGURE 18.—Perspective of circuit-closing press

Digitized by Google

unit, and, at the time of operation, grounded. The construction and arrangement of these pins is shown in figure 19. For actual operation, however, pins were provided only for that part of the card to be used in a specific tabulation.

When a card was placed in proper position, against the stops, each punched hole in the card would be exactly over one of the mercury cups; and when the pin box was brought down, most of the pins would be pressed back against their springs, but where the holes appeared in the card, the pins would go through, into the mercury, and thus come into electrical connection with the binding posts on the back of the machine.

The counters were arranged in a suitable frame, as shown in figure 17 or figure 20. The face of each counter was 3 inches square and was provided with a dial divided into 100 parts, and with 2 hands, one for counting units, and the other for hundreds. The counter consisted

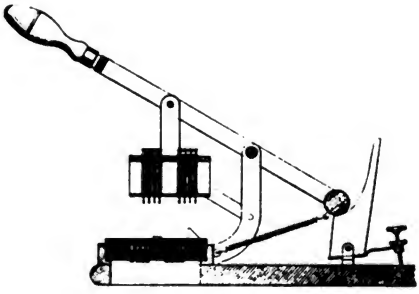


FIGURE 19.—Detail of circuit-closing press

essentially of an electromagnet, the armature of which was so arranged that each time it was attracted by the closing of the circuit it turned the units pointer enough to register one unit. A carrying device within the counter advanced the hundreds pointer one space each time the units counter made a complete revolution; thus each counter had the capacity of registering up to 10,000. When a single pack of cards numbered more than 10,000, a reading was taken at about the time the total counter reached this limit and completely recorded as a partial figure; these partial counts were then combined to provide the required data. The counters were so arranged as to be easily removable from the frame and interchangeable; merely placing the counter in the frame made all the necessary electrical connections. The counters could readily be reset to zero, though they had to be reset one by one.

Digitized by Google

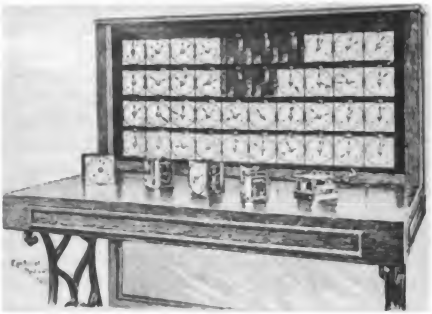


FIGURE 20.—Dial board, with detached counters

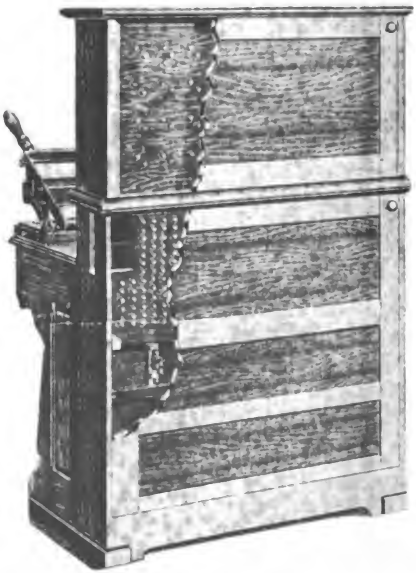


FIGURE 21.—Back of tabulating machine, showing binding posts

Digitized by Google

One pole of each counter socket was connected with the common or "ground" conductor, while the other pole was connected with one of the binding posts representing the mercury cups; thus, when the needle made contact with the mercury in a specified cup, the circuit was completed and the counter advanced.

There was one additional safety feature, however. In addition to the counting pins in the pin box, there was an extra pin with its mercury cup having mercury at a lower level than the rest, so that it made contact later than the regular pins. This pin and its mercury cup,were set into the ground circuit, so that no current could flow until this pin had made its contact. This was to avoid the sparking that might take place if the pins actually completed their circuits, one by one, thus limiting the trouble from this source to this single pin. Later a platinum contact device was substituted for this extra pin and cup.

In order to avoid false counts, or the skipping of a card which was incorrectly punched, the circuits were arranged to ring a bell each time a card was registered on a counter; and the cards which refused to count, and thus did not ring the bell, were laid aside for investigation and correction.

Wiring the tabulating machine.—The process of setting up the Hollerith tabulating machine for a specific run was a rather laborious and time-consuming task, since the wires from the several mercury cups in the press to the proper counters had to be soldered, individually—something which required highly trained and expert mechanics, since the wires were very small and the connections exacting.

Some of the connections which needed to be changed from time to time during a given "run" were made through the use of little cables plugged into one or another of a series of sockets in the head of the press. For example, the control pins for a given ED, which prevented the running through of a card from another ED, were changed by the operator, as she went from one ED to the next. And where it was arranged that certain cards should reject, for some temporary purpose (as for the recording of some very infrequent item or classification) there was a switch through the use of which the card could be replaced in the machine and counted.

The sorting box.—In addition to the counting device which constituted the main part of this equipment, there was a supplementary sorting box, shown at the right in figure 17 and in detail in figure 22, through the use of which the cards could be sorted into such groups as might be needed for later tabulations. This consisted of a box divided into compartments, each one of which was closed by a hinged lid. Each lid, as shown in figure 22, was held closed against the tension of a spring, by a catch in the armature of the electromagnet in front of the box. When the circuit was closed through this magnet, the armature was

758-612 O - 65 - 5

Digitized by Google

depressed, thus releasing the lid, which was opened by the spring and remained open until the operator, after placing the card in the box, closed the lid by a stroke of her hand. The sorting box compartments could be wired either to sort the cards in accordance with some of the items being tabulated (there were fewer compartments in the sorting box than there were counters on the dial board), or for other groups that might be desired, including groups that required for their identification the use of *two or more columns*. The sorting box was even used for sorting alone, though it was designed primarily as a supplement to tabulation.

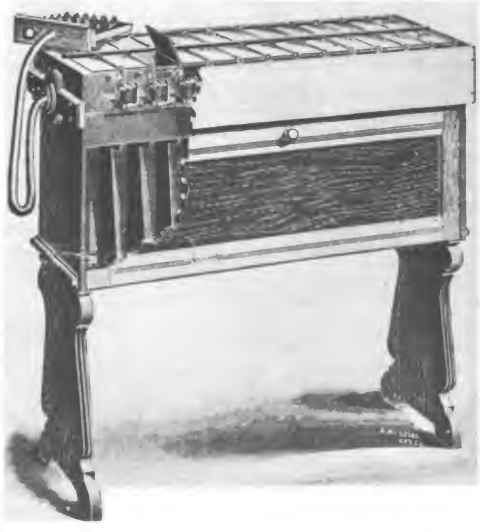


FIGURE 22.—Sorting box, showing release magnets and card pockets

Operation of the tabulating machine.—For comment on the operation of the tabulating machine we may again quote from Mr. Martin's article:

> If it is desired to know in a given enumeration district, or all of them, the number of males and females, white and colored, single, married, widowed, etc., the binding posts of the switchboard corresponding with these items are connected with the binding posts of the dials on which the items are to be counted. If it is also desired to assort the

Digitized by Google

cards according to age groups, for example, the binding posts of the switchboard representing such groups are connected with the clips into which the sorting box plug fits. The circuits being thus prepared, when a card is placed in position in the press and the handle of the pin box is depressed by the operator, so that the circuit is closed through each hole in the card, not only will the registration be effected on the counting dials, but the sorting box that has been selected for a given age group will be opened. The operator releases the handle, removes the card deftly from the press, deposits it in the open sorting compartment with her right hand and pats the lid down again, at the same time bringing another card into position under the press with her left hand. It is done much more quickly than it is described. When all the cards in any district have thus gone through the press, the record on the dials will show the number of males, females, white, colored, etc., while the cards will have been assorted into age groups.[7]

Next, the readings on the several dials were copied to result slips so arranged that the figures could be conveniently summarized and cross-added, in accordance with the requirements of the tables to be published. And all the counters were set back to zero. Note the number of hand operations to be performed: (1) Put card in press, with left hand; (2) depress head; (3) take card out, with right hand, and place on stack *or* place it in open pocket of sorting box and close box; (4) at the same time, place a new card in the press with the left hand; (5) listen continuously for bell; (6) copy figures from dials, on completion of ED or other area; (7) reset all dials, one by one.

Relays.—But the machine was capable of doing much more than to make a count of simple items like color or sex or marital status. The statistician needs to know, not only how many white persons there are in a given area but also how many of these are male or female, and how many of the white males are native or foreign born, etc. These combinations of characteristics were supplied by the Hollerith tabulator through the use of relays, so arranged that the circuit had to go through two or three or more different holes in the individual's card in order to actuate the specified counter. For these combination counts the machine was provided with relays, one type of which is shown in figure 23.

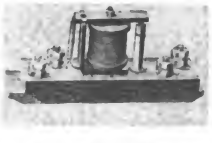


FIGURE 23.—Relay

These were arranged somewhat as illustrated in figure 24, taken from Patent No. 395,781. This diagram traces the two independent electrical circuits required—the relay circuit, in dotted lines, and the counting

[7] T. C. Martin, op. cit., p. 526.

Digitized by Google

circuit in solid lines. The relay circuit operates first, closing all the relays concerned in the given combination; then, the instant the last relay is closed, the counting impulse goes through and registers the count. Thus, to register a foreign-born white female, the current from the position representing "white" closes the first relay; that from the position representing "foreign born" closes the second relay; and that from the position representing "female" closes the third (it actually closes all three "female" relays), thus completing the circuit, ready for the counting impulse. Or one layer of relays might be omitted, for example, the white and colored. In this case the counting current would be wired through the white and colored contact pins and the remainder of the relays to the proper counter. In such a setup the actual counters would replace the lowest row of relays shown in the diagram; and there would be only two relays in the counting circuit for colored and six in that for white.

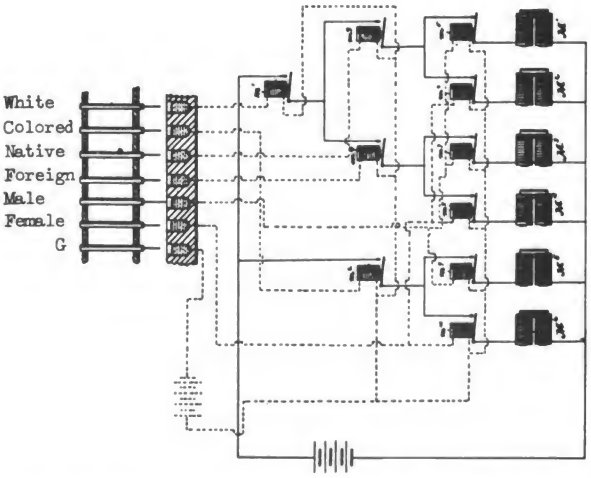


FIGURE 24.—Relay circuit (dotted lines) and counting circuit (solid lines)

Even the counting of an apparently simple item like age required the use of relays, since age was represented on the 1890 card by holes punched in two positions, one representing the 5-year group and another the units position within the group. Thus, the units position operated

Digitized by Google

a relay while the 5-year group position completed the circuit to the proper single-year counter. The card was planned in this fashion rather than with one position for tens and one for units (in spite of the fact that this made the punching much more difficult), in order to simplify the wiring required for tabulations by 5-year age groups, which were far more frequently called for than 10-year groups. Further, this pattern required only 5 relays for single years, rather than 10.

There seemed to be no absolute limit on the number of consecutive relays that might be set up in a tabulation scheme, though the larger the number of relays the greater the possibility of "difficulty" in the operation of the machine. Further, there were only 40 counters on the dial board, so that there was seldom any need for more than three, or possibly four, relays in a circuit. Further cross-classifications were obtained by sorting the cards for some of the characteristics in the combination and running them sort group by sort group, for the remaining elements on the classification. (See fourth count, p. 75.)

Controls.—In addition to the making of counts, both simple and in combination, the tabulating machine provided certain controls or verifications, as the cards went through. For example, the cards for each ED were identified by certain combinations of holes punched in the first four columns of the card. When a given ED was to be tabulated, the wiring was so arranged through movable plug-in cables that the current, before it could get through and actuate the counter (and ring the bell), had to go through the contacts established through the holes which represented the "code" for this ED. Thus, if a card for another ED had by accident gotten into the pack being tabulated, the current could not get through—and the silence of the bell gave notice that something was wrong. This was a verification of the geographic area which the tabulation was to represent.

Likewise a control could be set for any of the sort groups. For example, with the control set for male, any card representing a female would refuse to tabulate; and the same way with white or colored, etc.

Other verifications or consistency checks could be made in the same fashion: For example, in a tabulation of gainful workers by occupation, the machine could be wired to reject any card representing a person under 10 years of age. In 1900 and in later censuses, a machine was wired for a number of these consistency checks and the first run of the cards was designated the "verification run"; but it is not certain to what extent this possibility of machine verification was used in 1890.

Production records.—With respect to the speed with which the cards went through the tabulating machines, still another quotation from Mr. Martin's article is offered, again somewhat condensed:

> As a few figures were given from the records made with the punching machines, it may be worth while, in passing, to cite some that relate to the tabulation work. It was

Digitized by Google

stated that at the time of the writer's visit to the Census Office, 81 clerks had handled 556,346 cards that day, an average of 6,686 each. The "roll of honor," comprising the best individual daily records of successive weeks, ranges from 9,230 (with 4 readings) up to 13,356 (with 9 readings), with the highest individual record for a single day standing at 19,071 (with 9 readings).[8]

At later dates in the 1890 census period somewhat higher rates of production were attained, as the machine operators became more expert, averages ranging around 7,000 or 8,000 per day, and even higher for runs requiring few readings in proportion to the number of cards tabulated.

In later censuses (1900 and 1910) considerably better records were made with machines substantially the same as those used in 1890—and records up to 15,000 or more per day[9] with an improved type which required the operator simply to push a button in place of pulling down the handle of the press.

[8] T. C. Martin, op. cit., p. 528.

[9] E. Dana Durand, "Tabulation by Mechanical Means—Their Advantages and Disadvantages," in *Transactions of the 15th International Congress of Hygiene and Demography*, Vol. VI, 1912, p. 84.

Digitized by Google

Chapter IV. THE 1890 CENSUS OF POPULATION

The 1890 schedule.—The schedule used for the census of population in 1890 differed radically from that used either in earlier censuses or in subsequent enumerations, in that a separate sheet was provided for each family or household. This schedule occupied a sheet 10½ by 15 inches, with the questions arranged in the stub and a wide column provided for the entries for each individual. There were five columns on the face of the schedule, as shown in reduced form in figure 25, and five more on the reverse with provisions for using an additional sheet for any family with more than 10 members. In the heading of each sheet were several summary items, entered by the enumerator, including the number of families in the dwelling, the number of persons in the dwelling, and the number of persons in the family.[1] At the bottom of the second page were additional questions on tenure of home or farm, with mortgage status for owned homes or farms.

Punching the 1890 card.—The cards used in the 1890 census, as already indicated, were completely blank, except for the serial number printed vertically at the right-hand end. The location of the various fields was shown, however, on the reading board, which was printed exactly as the card would have been printed if it had been printed. Reference will be made, therefore, to the fields as shown on the reading board (see figure 16) as if they were identified on the cards that were being punched. Actually, they were identified, for the puncher, on the "keyboard" of the punching machine.

The first four columns of the card, divided in the illustration into six "fields" of two lines each, were to be punched on the gang punch, to indicate the geographic area to which the cards belonged. The remainder of the card was divided into "fields" corresponding roughly to the questions on the schedule, and arranged, first in a series across the upper part of the card, from left to right, then across the lower part of the card running from right to left—so that the card was punched across the top from left to right, then back, across the lower half, from right to left and finally up the left end. The cards were serially numbered and specific numbered cards were assigned to each ED—just cards enough for the population of the ED as shown in the preliminary count. Detailed instructions for the card puncher were substantially as follows:

[1] The 1890 schedule is reproduced in full in the first volume of the 1890 reports, *Eleventh Census of the United States, 1890*, Vol. I, Population, Pt. I, pp. cciv–ccv.

Digitized by Google

FAMILY SCHEDULE—1 TO 10 PERSONS. (Front.)

Eleventh Census of the United States.

Supervisor's district No. ——.
Enumeration district No. ——.

SCHEDULE No. 1.
POPULATION AND SOCIAL STATISTICS.

Name of city, town, township, precinct, district, beat, or other minor civil division. ——; County: ——; State: ——
Street and No.: ——; Ward: ——; Name of Institution: ——
Enumerated by me on the —— day of June, 1890. ——, *Enumerator.*

A.—Number of dwelling house in the order of visitation.	B.—Number of families in this dwelling house.	C.—Number of persons in this dwelling house.	D.—Number of family in the order of visitation.	E.—Number of persons in this family.

	INQUIRIES.	1	2	3	4	5
1	Christian name in full and initial of middle name.					
	Surname.					
2	Whether a soldier, sailor, or marine during the civil war (U. S. or Conf.), or widow of such person.					
3	Relationship to head of family.					
4	Whether white, black, mulatto, quadroon, octoroon, Chinese, Japanese, or Indian.					
5	Sex.					
6	Age at nearest birthday. If under one year, give age in months.					
7	Whether single, married, widowed, or divorced.					
8	Whether married during the census year (June 1, 1889, to May 31, 1890).					
9	Mother of how many children and number of these children living.					
10	Place of birth.					
11	Place of birth of father.					
12	Place of birth of mother.					
13	Number of years in the United States.					
14	Whether naturalized.					
15	Whether naturalization papers have been taken out.					
16	Profession, trade, or occupation.					
17	Months unemployed during the census year (June 1, 1889, to May 31, 1890.)					
18	Attendance at school (in months) during the census year (June 1, 1889, to May 31, 1890).					
19	Able to read.					
20	Able to write.					
21	Able to speak English. If not, the language or dialect spoken.					
22	Whether suffering from acute or chronic disease, with name of disease and length of time afflicted.					
23	Whether defective in mind, sight, hearing, or speech or whether crippled, maimed, or deformed with name of defect.					
24	Whether a prisoner, convict, homeless child, or pauper.					
25	Supplemental schedule and page.					

FIGURE 25.—1890 schedule, much reduced. The actual schedule measured about 10½ by 15 inches

Digitized by Google

Write in the schedule heading at the left of "Inquiries," the number of the first card punched from the schedule. This is for the person represented by the first column of entries; the next card will be for the person in column 2, etc. The card number for any other person will be a number greater by one-less-than-the-column-number. Thus, if the first card is No. 324, the card for the person represented by column 5 will be No. 328.

To check a card back to the schedule entries, one must find the schedule with initial number next lower than the card number; subtract this number from the given card number and count forward in the columns one less than this difference. For example, given card No. 788. You find a schedule with the initial number 784, or 4 less than your given number. This is the number for the first column on the schedule. To find the column for 788, count forward 4 columns, or to column 5. Or directly, add one to the difference, and consider that the column corresponding to your card.

In the first field on the card (see figure 16) punch the reply to schedule question 2, identifying Civil War veterans and their widows;

In the second field, punch the answer to question 3, identifying Head of family, his Wife, related Members, and Others;

In the third, very irregularly shaped field, punch color or race, as returned under question 4;

In the fourth, 2-position, field, cut in under the third field, punch sex, as reported under question 5;

In the fifth and sixth fields, punch the age reported under question 6, as follows: In the large field, punch the 5-year period in which the reported age falls, and in the small inset field punch the unit within the 5-year period; thus, for age 24, punch 20 in the first field, and 4 in the second; or for age 37, punch 35 in the first field and 2 in the second. For age reported in months, punch "Mo" in first field, then in the second, punch "0" for 0/12, "1" for 1/12 or 2/12, "2" for 3/12 to 5/12, "4" for 6/12 to 8/12, and "5" for 9/12 to 11/12.

In the 7th field punch conjugal status, as reported under questions 7 and 8, punching "CY" for persons married within the census year.

In the 8th field punch the number of children born, and in the 9th field the number living, as reported under question 9. For numbers under 6, punch simply the number in the upper part of the field; for larger numbers punch 5, 10, or 15, and an additional number in the bottom section of the field to make up the figure (thus, for 8, punch 5 and 3); and in the same manner make up totals beyond 10 and 15. For schedules with no reply leave these fields blank.[2]

[2] Query: There must have been some instruction for cases with children born reported under question 9 and no report on number living. But since no tabulation was made from this section of the card, there is no basis for reconstructing these instructions.

Digitized by Google

In fields 10 and 11, punch code symbols for place of birth—one series for States and another for foreign countries, thus: "Ag" for Connecticut or "Ka" for Germany. (A code list was supplied.)

In fields 12 and 13, going back along the bottom of the card, punch the country of birth of father and mother, as reported under questions 11 and 12. Note that these fields call for abbreviations for a selected list of countries, rather than for code symbols as in the preceding field.

In the 14th field punch number of years in the United States as reported under question 13; punch numbers under 6 as given; for years from 6 to 9, punch 6; for 10 to 14, punch 10, and for 15 or more, punch 15. Punch "Un" for foreign born with no report on years in United States. For native persons, leave this field blank.

In the little square field 15, punch citizenship for the foreign born. For native persons, leave this field blank.

In fields 16 and 17, punch occupation according to code symbols entered on the schedule under question 16, each code symbol comprising one capital letter and one lowercase. For a person with no occupation returned, punch "NG," for "nongainful."

In field 18 punch the number of months unemployed, as reported under question 17, *except* for a person punched NG in the occupation field leave this field blank.

In field 19 punch the number of months attending school, if any are reported; if not, then punch the replies to questions 18 and 19, as follows: for Yes–Yes, punch OK; for Yes–No, punch W—able to read but not to write; for No–No punch R—able neither to read nor to write. Punch R also for a person alleged to be able to write but not to read, with return No–Yes. If there is no entry whatsoever, punch OK.

In field 20, just above field 19, punch the replies to question 21, as follows: Answer Yes, punch En; Other language written in, if language of father (see question 11) punch Ft; etc. (Actually, to punch En for Yes, and Ot for all other cases would give all that was ever tabulated from this question.)

Field 21 is to be punched from questions 26–29, on the back of the schedule, for the head of the family only. (For nonhead persons, punch X.) Punch Fh for farm hired; Ff for farm owned free; Fm for farm owned mortgaged; and Hh, Hf, and Hm for homes in like status.

Advance editing.—Some editing was doubtless done on the 1890 schedules before they went to the punching clerks—probably about the same as in 1920. Certainly codes had to be supplied for occupations, or at least for all occupations except possibly a small number of occupations dominant in a given area, which the punching clerks might be expected to memorize. And some obvious omissions or inconsistencies may also have been taken care of in a preliminary checking over of the schedules.

Digitized by Google

The initial count of population and families.—The first count of the population returned in the 1890 census, termed by Superintendent Porter the "rough" count, was made through the use of a special setup of the Hollerith dial board in which the "press" was replaced by a small keyboard comprising two rows of keys, the first row numbered from 1 to 10, the second from 11 to 20, as shown in figure 26. This arrangement provided a count of families classified according to the number of persons in the family. The numbers of families in each group (1-person families, 2-person families, etc.) were recorded on two rows of counters on the standard dial board, with an additional counter in the row below which recorded the total number of families in the area, against which the sum of the several groups was checked. The total population of each was then obtained by multiplying the number of families in each group by the number of persons per family in that group.

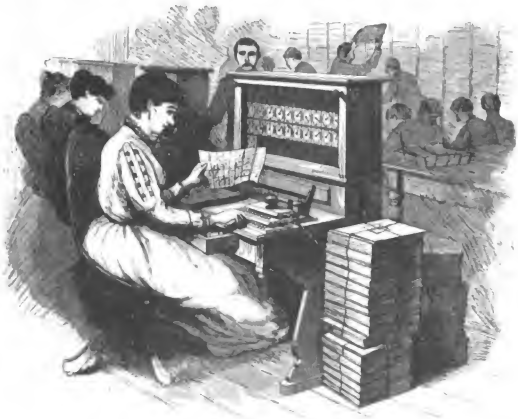


FIGURE 26.—Tabulating machine as adapted for family count

The operation of this device was simple, since each sheet of the schedule (except for an occasional overrun for a family of more than 10) represented a family and the number of persons in this family had been entered by the enumerator in a space in the heading of the schedule. (See figure 25.) All the operator had to do was to note this figure and press the corresponding key. It was noted in a contemporary article,[3] already referred to, that some operators handled in a single day schedules representing as many as 50,000 persons (9,200 families); and that the

[3] T. C. Martin, op. cit., p. 522.

Digitized by Google

entire census (comprising 12,690,151 families) was counted in a period of little more than 6 weeks. At any rate, the count was completed in time for a preliminary announcement of the population of the country on October 28, 1890.

This was followed by a similar count of *dwellings* classified by number of persons living in the dwelling. This count, again made direct from the schedules, was considerably more difficult than the first, since, for every dwelling containing more than one family, there were two or more schedule sheets, with the count of persons in the dwelling recorded only on the first of these sheets. The population totals obtained from this count were compared with the results of the first "rough" count, the differences reconciled, and the final population figures certified for use in Congressional apportionment on November 26, 1890.

For the larger cities (those over 100,000) there was an additional count of dwellings classified according to the number of *families* in the dwelling. This may have been done through a third handling of the schedules for these areas; but a classification of dwellings by number of families as well as by number of persons could readily have been obtained, with a single handling of the schedules, by adding, for these city areas, a third row of keys at the top of the little keyboard, with figures from 1 to 10, and another row of counters on the dial board, to record the count of dwellings by number of *families* in the dwelling. This new row of counters would then represent the dwellings grouped in accordance with the number of *families* in each, while the two lower rows of counters recorded, independently, dwellings grouped by number of *persons* in each. For this combination, of course, the operator would have to depress *two* keys, one for families and one for persons.

Two other partial counts were made direct from the schedules: A "special tally" by color, for the southern States, and a "special count" according to race, for the State of California.[4]

This outline of the details of the counts made before the cards were punched is based in part on the rather journalistic description presented in Mr. Martin's article, supported by brief statements in official reports and especially by an examination of the data on dwellings and families actually published in Volume I, Part I, of the 1890 Census Reports.[5]

The 1890 machine counts—general pattern.—In the following pages are presented a detailed outline of the first machine count of 1890, less detailed outlines of the next four counts, and a general description of the sixth and seventh counts. These outlines are to some extent "recon-

[4] See a statement by William C. Hunt, in charge of population statistics, published in *Senate Document 69*, 52d Cong., 1st sess. (1892), p. 13.

[5] The illustration shown in figure 26 is taken from the *Scientific American* for August 30, 1890. The printed statement accompanying this illustration corroborates the details presented above, except that it erroneously assumes that the total counter counted persons rather than families.

Digitized by Google

structed," in the same fashion as the 1880 tally sheets presented above, though with much more foundation in current official statement.[6]

In the reports of the 1890 census rather more stress was placed on figures for total native population and total foreign born than in more recent decades—when the most widely used summary figure for the foreign element in our population has been the foreign-born white rather than the total foreign born. But even in 1890 little space was devoted to the foreign-born Negro or the foreign-born colored (total nonwhite, including Chinese, Japanese, and Indians); and one of the problems that confronted the planners of the machine tabulations was the requirement, in some cases, for a tabulation of the foreign-born colored solely to round out the data for total foreign born.

The general classification as of native or foreign *parentage*, however, was for the most part limited to the native white population,[7] with only a single table (or two tables, counting one by States and one for principal cities) for the colored. Data for these tables could have been obtained, for the native colored, by two additional counters on the state-of-birth machine (third count, machine A), supplemented by a special count of the small number of foreign-born colored cards rejected from this run.

Tabulation areas.—One of the most important advantages of punched card tabulation as compared with the earlier tally system is the possibility of consolidating the cards into packs representing larger and larger geographic areas, thus saving literally acres of consolidation sheets. The 1880 tallies were without doubt made, in complete detail, by ED's and then consolidated into larger areas for publication. For the first count of 1890, as specified below, the ED's were assembled into counties, with places of 2,500 or more and wards in the larger cities kept separate; and no note was made of ED's except to record the total number of cards by ED's, for comparison with the earlier count of total population. This at once reduced the number of areas for which detailed readings were made by at least 80 percent.

Except for a single table (total foreign born by country of birth), all of the 1890 material actually published by counties was obtained from the first count, so that all later counts could theoretically have been made from the cards consolidated into much larger areas—specifically, with a pack for each major city and one for the balance of the State.

[6] Especially a detailed statement of the items tabulated, count by count, contained in a paper read by Robert P. Porter, Superintendent of 1890 Census, before the Royal Statistical Society in London, on December 4, 1894, and published in the *Journal of the Royal Statistical Society*, Volume 57, Part 4, December, 1894. This paper has already been referred to above, in connection with the 1880 program. Practically the same outline of the 1890 tabulations is given under the heading, "Form of Schedule and Method of Tabulation," on p. ccii in Pt. I of the 1890 Census Report on Population.

[7] Note, however, that in the detailed count by place of birth of parents, data on parentage in this detailed form were obtained for the foreign-born white as well as for the native—though one might question the value of data on country of birth of parents for persons who were themselves of foreign birth.

Digitized by Google

First Count—Color-Nativity by Age Groups

Here, then, is an outline, with detailed specifications, of the first machine count, which follows Mr. Porter's specifications in the matter of color, nativity, sex, and home tenure, but omits the additional classification of adult foreign-born males by naturalization status and ability to speak English, which his list also includes. There was no early publication of these data for the foreign born; similar figures, only for larger areas, were provided by a later count; and the first-count machine was loaded to capacity without these items.

In order to obtain data for the colored classes by nativity, which were needed to complete the count of total native and total foreign born, the machine was set to reject foreign-born Negroes and Indians, and native Chinese and Japanese. These were counted by nativity and recorded on a special sheet. Then, with a switch which permitted them to count, they were tabulated for the items on the dial board.

Areas, sort, and controls.—The areas represented by this count were counties, places of 2,500 or more, and wards of the larger cities. The cards were arranged by ED's within each area. The total counters only (1 and 3) were read by ED's and checked against ED totals from preliminary counts, both population and families. The cards were sorted by sex at time of punching, presumably verified by sorting needle. The controls were set for county or city, ED, and sex.

Counters—The items assigned to the various machine counters may be summarized as follows:

	Counter
Total number of cards	1
Detail of color (race)	7
Tenure of farms and homes, 6 counters plus 1 counter for nonhead persons (who do not enter into the count by tenure) and 1 for total families ("Heads")	8
Color-nativity (4 classes) by age (6 periods)	24
Number of counters, 40	

These counters were arranged on the dial board as follows:

Color		Tenure		Ages by color-nativity					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Grand total	Black	Total heads	Non-heads	NW/NP 0	NW/NP 1–4	NW/NP 5–17	NW/NP 18–20	NW/NP 21–44	NW/NP 45-plus [a]
(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Chi.	Mulatto	Farm OF	Home OF	NW/FP 0	NW/FP 1–4	NW/FP 5–17	NW/FP 18–20	NW/FP 21–44	NW/FP 45-plus [a]
(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
Jap.	Quadroon	Farm OM	Home OM	FBW 0	FBW 1–4	FBW 5–17	FBW 18–20	FBW 21–44	FBW 45-plus [a]
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)
Ind.	Octoroon	Farm R	Home R	Col. 0	Col. 1–4	Col. 5–17	Col. 18–20	Col. 21–44	Col. 45-plus [a]

[a] Probably included age "Unknown."

Digitized by Google

Checking against initial count.—The total counter should be checked against the population shown in the initial count, ED by ED. Likewise the "total heads" on counter 3 should agree with the number of families in the preliminary count.

Without question there were in operation in 1890 definite rules for the disposition of minor differences revealed by checking. Such rules have been in use at least up to 1950, though even in recent censuses, say 1930 and 1940, they were not written down for the record. Certainly a rerun of the cards, or a verification of the punching of the cards, would not have been made to eliminate a discrepancy of one or two units.

Use of fields on the card.—Since in only one case (tenure) did the card (see figure 16) provide a single punch-position for an element in this first tabulation, there is need for some further explanation of the various combinations of holes that were required to fill out the pattern outlined above. These explanations are presented herewith, field by field.

Color was recorded in the second field on the card, counting across the top from left to right, beginning with the symbol "Jp." Each position was wired singly into the machine.

The third field on the card recorded the information on age. The main field gave the 5-year age period, identified by the first figure; for example, "5" indicated age period 5–9. Unit ages within a period were punched in the small inset field, with figures 0 to 4, thus: "25" in main field, plus "2" in inset field represented age 27. The punch-positions in the main field operated the first series of relays in the age-relay block, and those in the inset field, the secondary or unit relays.

Nativity was tabulated from the last field, counting across the top of the card, the field with the capital letters. This field was designed primarily to indicate specific place of birth; but it was also used to indicate nativity, that is, to separate native from foreign born, as follows. Nine of these symbols, the first letters in a series of 2-letter symbols representing the States and territories[9] (plus the symbol "St," for State of residence), were tied together (by wires connecting their binding posts in the back of the tabulating machine) to represent native. Similarly, another group of letters, representing the first letters of the symbols provided for foreign countries, were tied together to represent foreign born. Either of these combinations operates when *any one position* in the group is punched.

The first two fields on the bottom of the card (counting from right to left, here) were used in similar fashion to indicate parentage. The right-hand field represented birthplace of father, the second field

[9] The first letter in this 2-letter symbol indicates the division in which the State is located, and thus may safely be used to indicate native birth.

Digitized by Google

birthplace of mother. The specific place-positions were here again tied together to afford the two-way classification as native or foreign born, though the group for father or mother native required the combination of only two positions, "US" and "Un." For father or mother foreign all the remaining positions in each field were tied together to operate as a unit—that is, again, to operate if any one position in the group was punched. As indicated in the wiring specifications below, a person was classified as of native parentage only if *both* father and mother were native, and as of foreign parentage if *either* father or mother was of foreign birth.

Wiring for the first count.—This first count required in some instances the combination of up to six items of information, represented by the same number of punched holes in the card. These combinations were obtained, to state it briefly, by arranging for the passage of the circuit from one punch-position through relays controlled by the remaining positions. A relay is a very simple device (see figure 23) operated by an electromagnet which closes a circuit through which another electric impulse may go, either to a counter, or, if further classification is required, to another relay. The relays were operated by their own independent electric circuit and were thus closed an instant before the counting impulse went through (15 of them for every card, though in no one case were more than 5 of them used). The general relationship between the relay circuit and the counting circuit is indicated in figure 24.

The progress of the counting impulses through the various relays which direct them to the proper counters may be outlined as follows for color, nativity, parentage, and age:

The current which comes through the hole punched "W" (white) goes first to a pair of relays for nativity: Nat (native)
FB (foreign born)

If the FB relay is closed, the current goes directly to a block of age relays (see detail below) and registers on one of the counters in the third line of age counters on the dial board (FBW, foreign born white, by age). Strictly, of course, the current does not "go" anywhere until the complete circuit is available, so that it can get all the way through and back to its source by way of the "ground."

If the Nat relay is closed, however, the current is directed to a pair of relays representing nativity of father: F Nat
F FB

If the F Nat relay is closed it goes then to a pair of relays representing nativity of mother: M Nat
M FB

If the M Nat relay is closed it goes to the first block of age relays and through these relays to one of the six age counters on the first line

Digitized by Google

of ages on the dial board (NW/NP, native white of native parentage, by age). Note that for classification as of native parentage, *both* parents must be native.

If, on the other hand, the M FB relay is closed, the circuit goes directly to the second block of age relays and thence to one of the counters in the second line of age counters on the dial board (NW/FP, native white of foreign parentage, by age). Note that if *either* parent is foreign born the person is classified as of foreign parentage. (The group was more specifically designated, in later censuses, as of "foreign or mixed parentage.")

Going back to the relays for nativity of father, if the F–FB relay in this set is closed, the circuit, bypassing the mother-nativity relays, goes directly to the second block of age counters (NW/FP, native white of foreign parentage, by age).

There were seven subclasses in the group generally designated "colored" in the 1890 reports, each having its separate position on the punch card. In order to get figures for native and foreign-born colored, the machine was wired, as indicted above, to reject the foreign-born Negroes and Indians and the native Chinese and Japanese, for a supplementary hand count by nativity. This was accomplished by wiring the Negro and Indian positions through the Nat relay (so that the FB cards would reject) and the Chinese and Japanese cards through the FB relay (so that the Nat cards would reject).[10] Then, through a switch, an alternative wiring was provided, which would permit these cards to tabulate through their set of age relays, as they would have done if this provision for rejecting had not been introduced.

For tenure of home, no relay was required. The current went directly through one of the seven punch-positions in this field to its respective counter. Cards for persons not heads of families (and thus not carrying any information about tenure) were recorded on counter 4, in order to provide a record of all cards tabulated.

Detail of the relays comprising the age block.—Note, first, that each reported age was represented on the punch card by two punches, one for the 5-year period in which the age stands and a second punch representing the position of the unit age within the 5-year period, thus: for age 22 "20" was punched (representing the age period 20–24) in the main age field, and in the units field "2." For persons under 1 year of age, punched "Mo" in the main age field, the units field indicated months or groups of months. If any tabulation of these ages by months was made, however, the results were not published.

[10] Provision is made for rejecting and hand counting that nativity class which is smaller; the other class is, of course, obtained by subtraction from the total recorded on the main result slips.

Digitized by Google

Some of the age groups called for by the first count were made up of complete 5-year periods, while others required certain 5-year periods to be "split" on the basis of the unit punches. The set of relays through which this was accomplished was repeated four times, one set for each of the four main population classes. The arrangement of the relays may be indicated as follows:

	Position punched in main age field	*Position punched in unit age field*
Age 0 (under 1)	Mo	
Age 1–4	0	
Age 5–17	5	
	10	
	15	0, 1, 2
Age 18–20	15	3, 4
	20	0
Age 21–44	20	1, 2, 3, 4
	25 to 44	
Age 45-plus	45 to 100 and probably Un	

As indicated in this diagrammatic presentation, for the first two age groups a single punch-position provides exactly the age required on the dial board; hence there is a single relay which, closed, directs the impulse to the specified counter. The third age group, 5–17, requires both the combination of two entire 5-year periods and the addition, to count on the same counter, of a part of a third group—split off through the use of a relay (one relay closed by any one of three punch positions in the unit age field).

The next age group, 18–20, likewise requires a part of age period 15–19, split off through the use of a relay closed by either 3 or 4 in the units field, plus a part of the period 20–24, split off likewise by a relay operated in this case, by the 0 in the unit age field. And so on.

For the age groups not requiring split periods, the first, second, and sixth, the current goes directly from the first relay to the counter, by-passing the units relay system.

Entries on result slip.—On the completion of the tabulation of the cards for a given area the operator transcribed the readings on the several dials to a transcription sheet or result slip. This sheet was presumably arranged in form similar to that of the dial board, in order to make the transcription as simple and "foolproof" as possible. For convenience in succeeding processes, extra space may have been allowed for totals and subtotals and possibly for figures from other sources that were to be compared in checking.

In the first count there would be two readings for each area, one for males and one for females. This was in addition to the noting of totals for each ED, or of totals as they stood at the end of each ED tabulated, for checking purposes.

Digitized by Google

Sorting box.—For this count the sorting box was set to sort by color and nativity, making 7 packs for each sex, as follows:

Native white, native parentage
Native white, foreign (or mixed) parentage
Foreign-born white
Negro (combining B, Mu, Oc, and Qd)
Chinese
Japanese
Indian

Publication from first count.—The only items published by counties from the first count were sex, color, and nativity. These were published also for places of 2,500 or more and for the wards of the larger cities. The only publication of age data in the first volume of 1890 reports is that in the chapter on "School, Militia, and Voting Age" (tables 63–72, pp. 733–825). There is in this volume[11] no publication of age by color-nativity, in detail as tabulated—nor any later use of these figures, as the age tables in Volume II came from the fourth count. The earlier figures may well have been published, however, in preliminary bulletins.

The cards might have been absolutely consolidated from ED's into counties and places of 2,500-plus, except for the need to check against the population totals for ED's, already available from the preliminary count. This check, however, would seem to have been essential.

The volume of consolidation work required to cross-add the age figures into color-nativity totals for the county tables was considerable; but since *all* of the 1880 tallies must have been done by ED's, the census staff was doubtless used to voluminous consolidation sheets. (Note that the consolidation of the cards into larger areas for the second and later counts, thus saving acres of consolidation sheets, was one of the big advantages of the card tabulation process.)

Second Count—Conjugal Condition

The second count, for conjugal condition, was set up in two parts, to provide, first, data classified by sex, color-nativity and age groups, by counties, with separate figures for cities of 25,000 or more, thus consolidating from the geographic arrangement of the cards for the first count all cities of from 2,500 to 25,000 within a county. The classifications provided by this part of the count are those actually published in the 1890 Report on Population (Vol. I), though the geographic detail was far greater than what was published in the report—notably in that the count afforded data for *counties* in detail parallel to that presented for States and large cities in the published tables.

[11] *Eleventh Census of the United States, 1890*, Vol. I, Population, Pt. I.

Digitized by Google

The second part of this count provided data, by sex, on conjugal condition of the population classified by birthplace of mother (12 countries) for use in the 1890 Report on Vital Statistics.

Conceivably, both age by color-nativity and country of birth of mother by age might have been tabulated in a single count from cards sorted by sex and conjugal condition, *except* that the number of counters required would exceed the capacity of even a 60-counter machine.

The number of counters might have been reduced by the introduction of an additional sort. But sorts were difficult, in the lack of mechanical sorters; and such additional sorts would greatly increase the number of time-consuming readings. It appears, then, that the most economical way of obtaining both the age classification and the country-of-birth-of-mother figures for vital statistics was to set up two machines, one for conjugal condition by age and one for conjugal condition by country of birth of mother. Specifications for these machines are presented next.

Machine A—Conjugal condition by color-nativity and age.—The count on this machine was made for cities of 25,000 and over and balance of county. The cards were sorted by color-nativity, with colored subdivided into Negro, Chinese, Japanese, and Indian, making 7 sort groups, or with the sort by sex, 14 sort packs for each area. The sort was provided by the sorting box in connection with the first count and arranged first by sex, with color-nativity for each sex. Controls were set for city or county, sex, and color-nativity.

Counters.—Items on the counters were set up on the dial board approximately as follows, using the symbols S for single, M for married, Wd for widowed, and D for divorced:

Conjugal condition by age (in years)									
S	S	S	S	S	S	S	S	S	S
0–14	15–19	20–24	25–29	30–34	35–44	45–54	55–64	65-plus	Unkn.
M	M	M	M	M	M	M	M	M	M
0–14	15–19	20–24	25–29	30–34	35–44	45–54	55–64	65-plus	Unkn.
Wd	Wd	Wd	Wd	Wd	Wd	Wd	Wd	Wd	Wd
0–14	15–19	20–24	25–29	30–34	35–44	45–54	55–64	65-plus	Unkn.
	D	D	D	D	D	D	D	D	D
TOTAL	15–19	20–24	25–29	30–34	35–44	45–54	55–64	65-plus	Unkn.

The combination of age groups with conjugal condition could have been handled completely, with no rejections for hand count, on a machine with 50 counters, plus one extra counter for total. Such a setup would put no more stress on the mechanism than a 40-counter machine, since only one counter is actuated at a time. (Machines with 60 counters were standard equipment in 1910, but no more than 40 counters were used in 1900.)

Digitized by Google

To bring the program within 40 counters, however, we must assume that 11 combinations are to be rejected and counted by hand. In the diagram presented above it is assumed that all cards showing conjugal status "Unknown" are to be rejected (that is, that no combinations be wired for them) and counted by hand—and likewise, to provide space for the total counter, any possible card for a person under 15 years of age reported as divorced. The whole number of persons reported with conjugal condition unknown in 1890 was only 70,214, or, roughly, about 1 card per ED, so the burden of hand tabulation under this condensed program was not very great.

Machine B—Conjugal condition by country of birth of mother.—The sort for this machine was the same as for machine A, sex by color-nativity, except that the four colored classes were consolidated. *Readings* were taken only for a completed sex group; but the color-nativity sort was retained (by separation cards) for use in the third count. The controls were set for county or city and sex.

Counters.—Since data on country of birth of mother were required for 12 countries (or groups of countries), the 40-counter dial board would provide for no more than three conjugal-status classes, single, married, and widowed. All cards for divorced as well as unknown were therefore rejected for hand count, making a potential total of 120,966—though even this number is less than two-tenths of one percent of the whole number of cards to be tabulated.

So far as concerns the pattern of the dial board, the counters might well have been arranged to record the data for three countries on a line, each country provided with a set of three counters, for single, married, and widowed. This would make, with the total, 37 counters used, to be arranged as follows:

TOTAL	United States			England and Wales			Ireland		
	S	M	Wd	S	M	Wd	S	M	Wd
	Scotland			France			Germany		
	S	M	Wd	S	M	Wd	S	M	Wd
	Scandinavia			Canada			Hungary		
	S	M	Wd	S	M	Wd	S	M	Wd
	Bohemia			Italy			Other countries		
	S	M	Wd	S	M	Wd	S	M	Wd

All the cards for a given area and sex were tabulated before taking a reading, as these figures were not required by color-nativity; but the

Digitized by Google

color-nativity sort (4 items) was kept for later counts, by the use of separation cards.

Sorting box.—No sorting box was needed. It was required simply to retain the sort by sex and color-nativity, with the colored in a single pack, then to rearrange the two sorts, making color-nativity the main sort, with separation cards for sex. The third count did not call for readings by sex, but the sort had to be maintained for later counts. (Note the possibility that it might have been more economical to disregard the sort by sex in this instance, and re-sort for the fourth count, since the sex sort, with each of the two classes represented by a single punch position in the card, was relatively easy to remake, through the use of the sorting needle.)

Publication from second count.—The results of the second count, machine A, that is, conjugal condition by color-nativity, sex, and age groups, were published in the last chapter in Volume I, Part I, of the 1890 reports. The full detail was given only for the United States, States and territories, and cities of 100,000 or over. Conjugal condition by sex alone was published for cities of 25,000 to 100,000. Consideration was presumably given to a similar publication by counties, parallel with the publication of country of birth for the total foreign born which was presented both for cities of 25,000 and over and for counties; but considerations of both time and space doubtless favored condensation, as the material for the first volume of the final reports approached completion.

It was doubtless noted that, for analytical purposes, the data on conjugal condition by sex alone, without the age classification, were of limited value (though such figures were published in the 1930 reports); but the publication of the complete detail of the count, by counties, would have required as many pages as there were counties—an utterly impossible assignment of space. Many hundreds of pages of consolidation sheets must have been required for the consolidation of the county figures into State totals; but, as already noted, the early census offices were used to extensive area consolidations.

The data obtained from machine B, conjugal condition by country of birth of mother, were published, in connection with statistics of deaths, in the Vital Statistics Report referred to above.[12]

---

[12] *Eleventh Census of the United States, 1890*, Vol. IV, Report on Vital and Social Statistics, Pts. I to IV. The tables involving country of birth of mother are listed on p. ix of Pt. 1.

Digitized by Google

Third Count—State or Country of Birth

The third count provided State of birth for the native population, white and colored, country of birth for the total foreign born, and naturalization status for adult alien males. By reason of the different classifications called for, it required three different machines for three different population groups, and a separation of the different classes to be run on the several machines. Thus, the native population was run on a machine wired to count State of birth; the foreign born on a machine wired for country of birth; and finally the adult alien males, sorted out in connection with the run for country of birth, were run on a third machine, wired for naturalization status, years in the United States, and possibly for ability to speak English.

Two extra items were added to the machine setup for State of birth in order to provide marginal data required in some of the summary tables, namely, counters (significant only for the native colored) for native parentage and foreign parentage; and instructions to make a special (hand) count of the rejected foreign colored by parentage. By reason of the small number of foreign-born colored cards (United States total, 127,740) this count was easily made without machine aid—along with the sorting of the foreign colored cards back to counties for consolidation with the foreign white to make total foreign born for the second machine.

Porter's Royal Statistical Society statement mentions a special count of persons born in State where enumerated by sex and 5-year age periods. This would require 21 additional counters, making a total of more than 60, and readings by sex, which are not otherwise needed. For this reason, and since none of this information was published, these details are omitted from the outline which is assumed to represent the third count as actually made. The statement also calls for a separate counting of foreign-born colored by country of birth; but no figures for the foreign-born colored were published, not even the United States total. (The figure given above was obtained by subtracting foreign-born white from total foreign born.) Thus, in view of the very small numbers of foreign-born colored cards in any county, the tabulation by country of birth has been set up for total foreign born, including colored.

The various details of this complicated run are presented in the following outline.

Areas, sort, etc.—For the foreign born the areas were the same as for the second count; that is, counties and cities of 25,000 or over. For the native white and the colored, the cards were consolidated into cities of 25,000 and over and remainder of State. Note that publication of data from this count by counties was limited to total foreign born by country of birth.

Digitized by Google

The cards were sorted by color-nativity and sex the same as for the second count, except consolidating all colored. They were arranged first by color-nativity and separation cards were provided for sex. No readings were taken by sex (except for foreign born by citizenship), but the cards for males and females were kept separate for the fourth count. Controls were set for area and color-nativity.

Machine A—State of birth.—The two native white groups and the colored were run on a machine set up for States and territories, with counters for possibly 37 States, in addition to the total counter. The remainder of the States, in general those with the smallest population, were to reject, be counted by hand and entered on a supplemental slip. But see the actual result slip used for the State-of-birth count in 1900, figure 34, below. With the control set for "Native," when running the colored cards, the machine would reject any foreign-born colored that might be included; these were later combined with the foreign-born white cards for tabulation by country of birth on machine B.

Machine B—Country of birth.—Machine B was set up for about 30 countries of birth and for citizenship (4 classes) of the male population 21 years old and over (with one counter for population under 21, excluded from the citizenship count, and perhaps one counter for total females). On this machine were run the foreign white cards and the foreign colored cards rejected from machine A, *combined* for readings, but keeping the foreign colored cards separate, since they would be combined with the native colored cards for the next count.

Machine C—For adult alien males.—This machine was set up with counters for country of birth, the same as machine B, with nine additional counters for years in the United States. On this machine were run the cards for all alien males 21 and over resulting from the sort in connection with the run on machine B.

This count did not involve the use of any new fields on the card, but one special adjustment had to be made, as the work on State of birth proceeded from State to State, to assure the proper allocation of cards punched "St," that is, State of residence. In earlier counts, this symbol was combined with the specific State symbols to denote native birth; but for this count it had to be combined, State by State, with the symbol for the State which was being tabulated.

Sorting box.—The native cards tabulated on machine A were sorted into 21 5-year age groups, as required for the fourth count. On machine B, for the foreign born, one box was reserved for alien males 21 years old and over (for machine C), and the remainder of the cards were sorted into 5-year age periods, as indicated for machine A; and likewise on machine C. All of these packs of cards sorted by age were eventually assembled for the fourth count.

Digitized by Google

Publication.—The results of the tabulation of the native population by State of birth form one chapter in Part I of Volume I of the 1890 reports, presenting figures by States and for cities of 25,000 and over.

The results of the tabulation of the foreign-born population by country of birth likewise form a single chapter in this report, comprising three tables, giving, first, full detail by States, then a table with a condensed list of countries of birth for counties, and finally a table giving the full detail for cities of 25,000 and over.

The results of the tabulations by citizenship and time in the United States are presented in a chapter late in Part II of Volume I, entitled "Citizenship of Foreign-born Males 21 Years Old and Over."

Fourth Count—Single Years of Age, Illiteracy, School Attendance, etc.

To obtain the extensive detail of single years of age and various other classifications by age periods, this count had recourse to a very detailed sort, comprising the earlier sorts by color-nativity and sex, plus the age sort made in the sorting box at the end of the third count. With all this detail taken care of in the sort, the machine wiring was relatively simple, requiring no relays except for the switch (or special machine) to separate Negro from the other colored. The details of this count may be outlined as follows, covering single years of age, school attendance, illiteracy, and veteran status, all by color-nativity and sex:

Sort.—Color-nativity (all colored as one unit) and sex, by 5-year age periods (the age groups punched in the main age field of the card), potentially 168 packs of cards per area—2 × 4 × 21. The sort groups were presumably arranged thus:

Native white, native parentage
- Under 1 year ("Mo.")
  - Male
  - Female

  For this group the unit age counters would record young children by months of age.
- 1–4 years
  - Male
  - Female

  For this group the unit age counters would record ages from 1 to 4.
- 5–9 years
  - Male
  - Female

  For this group the unit age counters would record ages from 5 to 9.
- Etc.

Native white, foreign parentage
- Same.

Foreign-born white
- Same.

Colored
- Same.

Digitized by Google

Machine setup.—The machine counters were wired as follows:

	Counter
Total number of cards	1
Veteran, Union	2
Veteran, Confederate	3
Not a veteran	4
Age unit 0	6
Age unit 1	7
Age unit 2	8
Age unit 3	9
Age unit 4	10
(These unit ages, in combination with the 5-year age groups in the sort, give age in single years.)	
School attendance, 0	11
School attendance, 1 month	12
School attendance, 2–3 months	13
School attendance, 4–5 months	14
School attendance, 6 or more months	15
Illiteracy, OK, literate	16
Illiteracy, W, can read but not write	17
Illiteracy, R, can neither read nor write	18
Able to speak English, En, Un	19
Not able to speak English, Ft, Mt, Ot	20
Country of birth of mother: United States, England, Ireland, Scotland, France, Germany, Canada, Scandinavia, Hungary, Bohemia, Italy, other countries	21–32

To obtain separate figures on school attendance and illiteracy for Negroes and other colored the control was set for Negro only (B, Mu, Oc, Qd), so that cards for Chinese, Japanese, or Indians would reject, to be hand tabulated for school attendance and illiteracy, then counted in with the Negro cards, by use of a switch, for single years of age and country of birth of mother.

New fields on the card.—This count used three new fields on the punch card, namely, ability to speak English, veteran status, and illiteracy–school attendance.

Ability to speak English, or, better, from the point of view of the card puncher, language spoken, was punched in the little 5-position field just under tenure, at the left-hand end of the card. For this tabulation, "En" meaning able to speak English (combined with "Un," giving the benefit of the doubt to unedited blanks) formed one of the two items used; the remaining symbols tied together formed a second item, meaning not able to speak English.

Veteran status was tabulated from the very first field at the top of the card, tying together for Union veterans the three symbols UM, UL, and US; and likewise the three symbols for Confederate veterans, while the

Digitized by Google

last symbol, No, represented nonveterans. Veteran status counted for females would of course represent veterans' widows.

School attendance, in terms of months attended, was punched in the lower part of the last field at the bottom of the card; that is, the one at the left, next to the geographic code section which occupies the four columns at the extreme left. The figures were tied together in groups, as indicated in the outline above, with "0" for not attending school.

Illiteracy was indicated in part by the symbols punched in the three lettered positions at the top of the school attendance field; thus, OK indicated able both to read and to write, "Yes–Yes" on the schedule; W indicated able to read but not to write, "Yes–No" on the schedule; and R indicated not able to read or write, "No–No" on the schedule (or the rather improbable "No–Yes" for a person alleged to be able to write but not to read, which was not counted separately in the tabulation). All persons 10 years old or over attending school were also counted as literate.

Sorting box.—For the native white of native parentage and the colored alone, the sorting box was set for the first sort in the series of sorts for occupations, allowing the cards to accumulate throughout the series of age groups, since the age sort was not needed in the occupation count. For the foreign parentage native whites and the foreign born the cards were sorted by country of birth of *father* for the fifth count, again allowing the cards to accumulate throughout the age series. Sixteen countries were required, as follows: United States, Ireland, Germany, England, Scotland, Wales, Canada (English), Canada (French), Sweden, Norway, Denmark, Bohemia, France, Hungary, Italy, Russia, and Other countries.

This fourth count required far more extensive recording sheets (or "result slips" as they were later called) than the earlier counts; but in effect it represented the tabulation of five different subjects, cross-classified by three or four or five other items. The main burden of the consolidation process was to subdivide the single column of 168 (potential) lines on the result slip into smaller sections, for convenience in addition and checking.

Publication.—The results of this fundamentally important count were published, at least by States, in almost the full tabulated detail, except that there were well selected age groupings in the cross-classifications, in five chapters of the 1890 Report on Population, Volume I, Part II. The chapter on single years of age, by color-nativity and sex, alone occupied 134 pages. The chapters on school attendance, illiteracy, and ability to speak English—or strictly, inability to speak English (the chapter is entitled "Cannot Speak English")—present the data cross-classified by color-nativity, sex, and appropriately condensed age groups.

Digitized by Google

The final chapter on veteran status, entitled "Soldiers and Widows" is rather briefly presented, with one classification by color-nativity and one by broad age groups.

The tabulations by country of birth of mother were made for use in the Vital Statistics reports[13] and appear in the various connections in these reports rather than in any of the population reports.

Fifth Count—Parentage in Detail

The whole population had already been classified as of native or foreign parentage (see third count for this classification of the colored). The purpose of this fifth count was to show the specific countries of birth of the foreign-born fathers or mothers involved, in all possible combinations. This tabulation was made only for native white of foreign (or mixed) parentage and foreign-born white, as there were too few colored of foreign parentage to justify further tabulation.

In preparation for this count the cards for these two nativity classes were further sorted by country of birth of *father* through the use of the sorting box in connection with the fourth count, but with the age groups consolidated. Presumably the cards for males and females were kept separate, by separation cards, throughout the fifth count (for use in the occupation counts that followed), though one might suggest that it would be easier to make the simple sort by sex than to handle so many separation cards, especially as the cards would be largely "bunched" from the previous sorts by sex, and thus much more readily and rapidly sorted by the use of the sorting needle.

Areas, sort, etc.—The areas for this count were cities of 25,000 or over and balance of State. The cards for native white of foreign or mixed parentage and foreign-born white were sorted by country of birth of *father*, as indicated above.

Machine counters were set up for country of birth of mother, using the following countries (plus the United States):

Ireland	Canada (French)	France
Germany	Sweden	Hungary
England	Norway	Italy
Scotland	Denmark	Russia
Wales	Bohemia	Other countries
Canada (English)		

Note that these are exactly the countries assigned punch positions on the card. This made a very simple machine, with 18 counters, including the total counter, and requiring no relays.

[13] *Eleventh Census of the United States, 1890*, Vol. IV, Report on Vital and Social Statistics, Pts. I–IV.

Digitized by Google

Publication.—In the published report [14] figures were shown by States (and for individual cities), for the countries listed in all possible combinations involving only one specific country (persons with fathers born in specific countries and mothers in the United States, persons with fathers born in specific countries and mothers in some other foreign country, etc.), and also for persons with both parents born in the same foreign country, but the combinations of countries for persons of mixed foreign parentage were shown, by States only, for only 60 combinations, or about one-fourth of the possible combinations of 16 countries. This included, however, all the combinations represented by as many as 1,156 persons; and a practically complete cross-classification was shown, for the United States total, in the introductory part of the report. While some items were shown separately for native and foreign-born white, the stress was upon the total white population classified by parentage (a foreshadowing, perhaps, of the later "foreign white stock").

Sixth Count—Occupations by Sex, Color-Nativity, etc.

The fundamental characteristic of the sixth count was that the cards were sorted by occupations, with 224 codes, representing 224 occupations or occupation groups. These codes as punched in the cards were made up of combinations of one capital letter and one lowercase letter in the two large fields about the center of the lower part of the card. The cards for persons under 10 years of age were laid aside; and the remaining cards were kept in their basic sorts by color-nativity (with Negro separate from "other colored") and sex, and each of these groups (10 packs of cards for each area) was sorted by occupation—making this count the most extensive and complicated of the series.

For the fourth count (the next most detailed) the colored cards had been consolidated into one general class (Negro plus Chinese, Japanese, and Indian) but for the occupation count the non-Negro colored were separated out again. By what process it is difficult to conjecture. The sorting machine, as it is now known, was not available; and because the punched symbols for the Negroes, who would dominate the group in practically every area, were distributed over four punch-positions (B, Mu, Qd, Oc) the sorting needle would not be very effective. But the demand for data for Negroes alone seemed to justify the labor required.[15]

The specifications for this count are summarized below. The machine provided seven different classifications of the workers in each occupation

---

[14] *Eleventh Census of the United States, 1890*, Population, Pt. I, pp. cliv–clxxv and 679–727.

[15] A simpler, or at least less laborious, method of obtaining the separate figures for Negroes and "other colored," for most areas, would have been to set the color control for Negroes only, so that the usually small numbers of Chinese, Japanese or Indians would reject, to be counted by hand and then tabulated with a special switch. This method may actually have been used.

Digitized by Google

group, for the most part repeating classifications already tabulated for the general population.

Areas, sort, etc.—This count was made for cities of 50,000 or more and balance of State, involving no change from preceding count except for throwing cities of 25,000 to 50,000 into "balance of State." The five color-nativity groups were arranged by sex, making 10 packs for each area. Each pack was then sorted by occupation. There were in all 224 occupation classifications, but for many of the basic groups only a small fraction of this number were represented; and one of the main tasks of the machine operator was that of correctly recording the occupation on the result slip, from the occupation code punched in the card.

Controls were set, presumably, for color-nativity and sex only. The areas were relatively large and therefore not likely to be mixed; the occupations were so frequently changed as to make it burdensome to change the control for each new occupation symbol.

Machine setup.—The machine for this count was wired as follows:

	Counter
Total number of cards	1
Age groups (10–14, 15–19, 20–24, 25–34, etc. to 65-plus and unknown)	9
Conjugal condition	5
Illiteracy	2
Ability to speak English	2
Unemployment (under 1 month; 3–4 months; 4–5 months; 6 months or more; not unemployed)	5
Veteran status (Union; Confederate; nonveteran)	3
Birthplace of mother	12

Number of counters, 39

Card fields.—Months unemployed was punched in the narrow vertical field on the card just to the left of the lowercase occupation code field, in single months as reported; for tabulation these were grouped into four periods, as indicated; for gainful workers not unemployed, the punch would be either "Oc" or "O", making a fifth counter, in order to take care of all the cards.

The data on birthplace of mother were required only for the native white of foreign parentage and the foreign-born white, so the machine may well have been provided with a switch to switch these counters out of the circuit when running cards for other classes.

Seventh Count—Occupations of the Foreign Born by Country of Birth

For the seventh count, providing significant data for foreign-born workers, first by country of birth, and then for those 21 years old and over, by citizenship, and for aliens, by number of years in the United States (punched in the third field from the right, in the lower part of the

Digitized by Google

card), the foreign-born colored cards were sorted out [16] and added to the foreign born white, to make total foreign born. There were then, for each area, only two main groups of cards, representing foreign-born males and females, subsorted by occupation.

Areas, sort, etc.—The areas for this count were the same as for the sixth count. The seventh count used only the foreign-born white cards from the sixth count, plus the foreign-born colored, which were sorted out from among the colored cards, keeping the sex and occupation sorts throughout. The only control needed was nativity.

Machine setup.—The machine for this count was wired as follows:

	Counter
Total number of cards	1
Country of birth	15
Citizenship of persons 21 years old and over, with years in the United States for aliens	7

Number of counters, 23

The citizenship counters needed to be read only for males, and might have been arranged to switch out for the female cards, though these would be relatively few, so the saving might not have been worth the trouble of setting up the switch and using it very frequently.

CHARACTERISTICS OF HOME PROPRIETORS

In a report entitled "Farms and Homes: Proprietorship and Indebtedness," [17] published in 1895, were presented various classifications of "proprietors," that is, persons owning or hiring homes or farms, which could hardly have been obtained from the regular population cards, since they were based on the census returns for the owner, in the case of owned homes or farms, rather than for the head of the family; and this person was not identified on the population card. One might assume, therefore, that special cards were punched for these proprietors, though the specific data involved are all included on the regular population cards. Conceivably, the population cards might have been sorted back to schedule order and the cards for the actual owners (not always the head of the family) selected on the basis of the name of the owner as reported under the question on tenure. In fact, there is a statement in the report of the Superintendent of the Census (Mr. Porter) for the year

[16] This sort must have been rather difficult, since there was no single punch position in the 1890 card to identify either native or foreign born. But for the sorting needle there would be many packs of cards with identical State-of-birth codes, and even more packs with identical division-of-birth codes which would serve equally well to identify the native persons who would comprise by far the larger part of the colored population. Or the sixth count might have provided that the foreign-born colored cards be rejected for identification, counted through the use of a switch, and then laid aside for the seventh count.

[17] *Eleventh Census of the United States, 1890*, Vol. XIII, pp. 161 ff.

Digitized by Google

ending June 30, 1893, to the effect that cards for certain limited classes were being sorted out for tabulation, including aliens, war survivors, and "those owning or renting homes or farms." But sorting was a slow process, in the lack of efficient sorting machines; and no specific statement has been found with respect to the exact method employed in this tabulation.

The statistics were published only for relatively large areas: States, the 11 cities of 250,000 or over individually, and a total for the 47 remaining cities of 50,000 or over, combined.

The classifications included color (white, Negro, mixed, Indian, and Chinese-Japanese) in combination with sex; nativity of the white proprietors (native, with 11 specific countries for the foreign born); parentage (native and foreign or mixed) for the native white; and age groups (5-year periods from 25 to 60), all in combination with sex. All of these details were shown for proprietors classified according to tenure into six classes: farm owners, free; farm owners, mortgaged; farm renters; home owners, free; home owners, mortgaged; home renters.

All of these data could readily have been tabulated from one run of the cards, sorted by tenure, with sections of the tabulating machine set up in the same fashion as for the general population tabulations involving the same classifications.

Note that this publication of data from the 1890 population schedule in reports other than those specifically labeled "Population" is in some respects similar to the publication of data by country of birth of mother in the vital statistics reports; but there is this difference. The country-of-birth-of-mother figures covered the entire population and were secured simply by putting additional counters (or making additional runs) on certain of the machines designed for the regular population reports, while for the "proprietors," as indicated above, there was required a selection of individuals identifiable only (or mainly) by reference to the schedules.

SUPPLEMENTAL TABULATIONS PLANNED FOR 1890 DATA

After the completion of the occupation counts, the 1890 cards were arranged for supplemental counts for which, one must assume, needed additional funds were not forthcoming. These counts were designed to provide detailed information about the illiterate, non-English-speaking elements in the population, and "a most complete presentation regarding the relative fertility of women of different nationalities." This last would have taken the form of a tabulation of the returns on the number of children ever born and the number living, a new inquiry incorporated in the 1890 census and already punched in the 1890 cards.

Digitized by Google

This inquiry was repeated in 1900, punched in the 1900 family card, but again not tabulated; carried on the schedule in 1910, but not even punched in the card; omitted in 1920 and 1930; and repeated on a 5-percent sample basis in 1940, for children ever born only.

The 1940 data were tabulated in combination with various other characteristics significant for analysis of fertility trends; and for comparison a specially selected sample of the 1910 returns was tabulated in parallel fashion. The question has been continued, always on a sample basis, in subsequent censuses.

758-612 O - 65 - 7

Digitized by Google

Chapter V. THE 1900 CENSUSES OF POPULATION AND AGRICULTURE

MACHINERY USED IN THE CENSUS OF 1900

All of the machinery used in the tabulation of the 1900 census of population was rented, as in 1890, from the Hollerith Co. and was, in general, similar to that used for the 1890 census, with the cards fed into the machine by hand. There was added, however, a schedule-holder for the 50-line sheets of the 1900 schedule. This consisted of a large cylinder around which the schedule was placed, supported on a convenient rack in front of the puncher. There was a narrow space through which only a single line of the schedule was visible, successive lines coming into view as the operator pushed a lever to advance the cylinder another notch. This schedule holder was similar to the one illustrated in figure 49, except that it did not have the built-in light.

The Hollerith automatic tabulating machine.—Toward the end of the 1900 census period the Hollerith Co. developed a so-called automatic tabulating machine, into which the cards were fed automatically, rather than being inserted one by one by hand. The results were read from the familiar dials, however, and the counters had to be set back to zero, one by one, after each reading. A picture of this machine which appeared in an article by W. R. Merriam, then Director of the Census, published in 1903,[1] is reproduced in figure 27. The machine comprised two parts, the familiar 40-counter dial board, set on a table, with space in front of it for the result slips to which the figures were to be transcribed; and, standing at the right of the table, a reading head somewhat similar, so far as one can judge from the picture, to the reading heads of the automatic tabulators later developed in the Census Machine Shop and in limited use in 1911 and 1912. It would not appear, however, that this automatic machine was used to any great extent with 1900 census cards. It was stated, however, that the record run on this machine was 84,000 cards in one working day as compared with an average of 8,000 or 10,000 cards on the hand-feed machine.

The Hollerith integrating tabulator.—For the census of agriculture, however, special machinery was developed, as indicated in the discussion of the several steps in the work on this census, as outlined below. The fundamental difference in the machine requirements of these two branches of the census work was that, while the population census

[1] W. R. Merriam, "The Evolution of Modern Census Taking," *Century Magazine*, April, 1903, p. 839.

Digitized by Google

required only the counting and accumulation of single units, one unit for one person in the population, the agricultural census required the aggregation of larger numbers, the addition of the acreage of farm after farm, or of the number of bushels of corn produced. In other words, it required an adding (or "integrating") tabulator, rather than simply a counter.

The major part of this report relates to machinery for counting units, since this process covers by far the greater part of the work of tabulating population. But Hollerith had realized at an early date that there would be need also for a machine that would add numbers larger than one, as witness the fact that he had filed an application for a patent on an integrating tabulator as early as January 4, 1887.[2] The first recorded

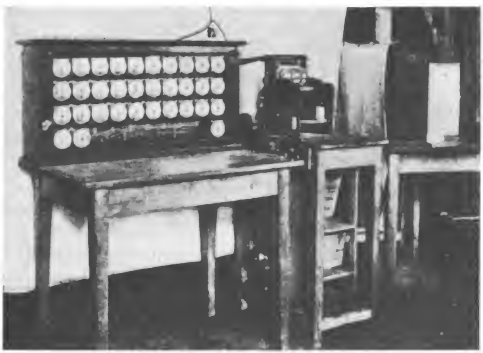


FIGURE 27.—Hollerith automatic tabulating machine, around 1902

need for such a device came up in connection with work in the Office of the Surgeon General of the Army, where his machines were installed in 1889. One of the items required here was a summation of the time lost by soldiers on account of illness, the recorded monthly figures ranging from 1 to 31.

The basic new element in the integrating counter devised for this task was a cylinder having on its surface 9 strips of conducting material, of graduated lengths, as shown in ultrasimplified form in figure 28, with a parallel row of brushes so adjusted as to produce an electric impulse each time they crossed one of these strips. That would mean 9 impulses if the brush was set close to the (left-hand) end of the cylinder, or a smaller number if it was located farther to the right. These brushes

[2] The patent, No. 430,804, was granted June 24, 1890.

Digitized by Google

were arranged in a row, across the length of the cylinder, and connected with the mechanism of the "standard" card press. When the card press encountered a "9" the first brush, so located as to engage all 9 of the parallel strips, was connected to the proper counter, and this counter received 9 impulses, to advance it 9 units. The actual selection of the digit to be added, it may be noted, was provided by the connection with one or another of the brushes; the essential contribution of the cylinder with its parallel strips was to provide the proper number of impulses.

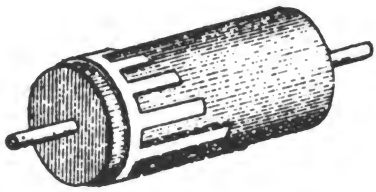


FIGURE 28.—Cylinder for integrating tabulator

The mechanism was so constructed that the cylinder made a complete revolution for each card that was tabulated. In its simplest form, as represented in Patent No. 430,804, dated June 24, 1890, a separate recording counter was provided for each digit-position in the numbers to be added—one for the units place, one for the tens place, etc., these subtotals to be added together to produce the final total. But there was an additional device for carrying the amounts forward from one digit-position to the next, so as to produce directly a complete total of the amounts punched in the cards. It is possible that the simpler form was used in the Surgeon General's Office, where the demands were rather limited; but the pattern with the automatic carryover must have been used for the farm census, and presumably in the commercial installations undertaken between 1890 and 1900. It would seem quite obvious that the integrating or adding tabulator was far more complicated than the machine which counted units of population.[3]

The electric sorting machine.—As the work on the census of agriculture progressed, it became evident that some more rapid method of sorting was required (more rapid than sorting by hand, with the help of the sorting needle) in order to keep ahead of the tabulating machines. As this situation approached emergency status, the Hollerith Co. made

[3] For an early description of Hollerith's adding tabulator see "The Electrical Tabulating Machine Applied to Cost Accounting," in the *American Machinist* for July 31, 1902. This article carries an illustration of a machine with three sets of counters, similar, on a smaller scale, to those used in the 1900 farm census and illustrated in figures 37 and 40.

Digitized by Google

a special effort to construct an automatic sorting machine, especially for use with the very numerous crop cards. Twenty of these machines were finally manufactured and put into use for the latter part of the census period. These machines were eventually sold to the Census Bureau, at a relatively low price—or perhaps more accurately, they were made specifically for the Bureau, which paid for them little more than the cost of materials and labor used in their construction, the company making this contribution in order to ensure the satisfactory operation of the tabulating machines for which they were receiving rental.[4] They were apparently rather crudely made, and, as one might expect from machines put together under pressure and hardly past the experimental stage,

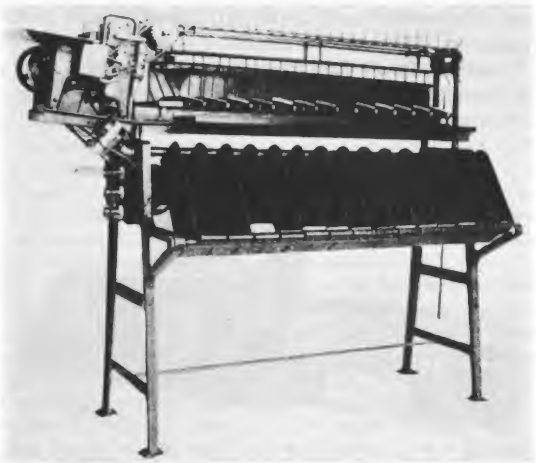


FIGURE 29.—Electric sorting machine, around 1901

required frequent repairs and adjustments. But they did serve an important purpose; and no later censuses were undertaken without the aid of electric sorting machines. One of these machines is illustrated in figure 29.

[4] Complaint of Tabulating Machine Co. in suit against E. D. Durand, in 1910, as quoted in Holley, *Machine Tabulation in the Census Office, 1870–1912*, MS, p. 39. Quoting specifically, "... to meet this emergency complainant offered to build and supply the then Director of the Census twenty electrically controlled automatic card-sorting machines; that the complainant was paid for said machines on the basis of a small percentage above the cost of labor and materials; that this represented practically no profit to the complainant, but it was willing to furnish such machines ... as an adjunct to its agricultural tabulating machines already in use."

Digitized by Google

The gang punch for agriculture.—The gang punch was used for punching into the agriculture cards the symbols indicating geographic area, the same as with the population cards. The scope of the gang punch was somewhat extended for agriculture, however, to cover two or three classification symbols also, including, for the farm card, symbols in the upper margin of the card as well as in the geographic-identification space at the extreme left. The gang punch machines were similar to those used for population cards (see figure 14, above), except that the one used for the farm cards was built on a smaller scale, by reason of the closer spacing of the columns on that card.

The key punch used for agriculture.—The farm census cards were punched on a machine much simpler than the pantograph punch used for population. This machine, illustrated in figure 30, was provided with 10 keys for the 10 digits, plus an extra key marked "X" which caused the card carriage to skip to the next field in specified cases where there were no entries for one or more of the fields on the card.

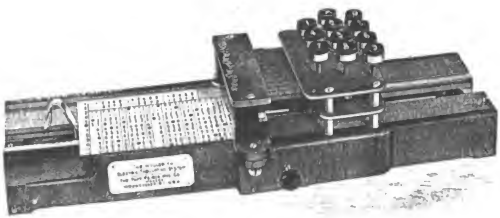


FIGURE 30.—Key punch used in 1900 census of agriculture

The key punch (sometimes called the commercial punch) was much more rapid, in proportion to the number of items to be punched, than the pantograph, though for the most part it required that the data to be punched be expressed in numerical form. It was thus well adapted to the farm census, since most of the agricultural data were already expressed in figures, as contrasted with the population material, much of which was in the form of class designations, like country of birth or marital condition. (Eventually, in 1930, the population material was adapted to this machine, at the expense of some additional coding. See p. 161, below.)

Digitized by Google

Summary of machine equipment.—According to Director Merriam's last report, dated November 1, 1902, the tabulation of the 1900 census made use of the following items of mechanical equipment:

1,642 punches (including 700 pantograph punches, later purchased by the Bureau from the Hollerith Co.)
311 electric tabulating machines (counting both those used for population and those used for agriculture)
215,000,000 cards for these machines
74 adding machines

It was noted also that an estimated 2 million percentages were worked, though there is no information as to whether any mechanical devices were used in this work. (Possibly the Thatcher slide rule, or "squirrel cage," of which five or more were specifically reported as in use in the 1910 census period.)

THE 1900 CENSUS OF POPULATION

The Twelfth Census of Population (1900) employed, in place of the family schedule of 1890 (one sheet for each family), a line schedule similar to that of 1880, described above, affording space for recording the returns for 50 persons on each side of the sheet, or 100 persons per sheet. This general form of schedule, it may be noted, was used in the earlier censuses from 1850 to 1880, and also in later censuses from 1910 to 1940. The specific questions on the 1900 schedule are listed below, in connection with the instructions for punching the population cards.

Except for a brief statement contained in the Report of the Director of the Census dated November 1, 1900, it would be assumed that the preliminary count of the population had been obtained, as it was in later censuses from 1910 to 1940, by summing up the numbers of persons recorded on the several sheets of the schedules. This statement, which appears on page 16 of the Report, says that the population count was "ascertained through the means of the use of the Hollerith tabulating machines, instead of the usual count ascertained from a computation of the names upon the various schedules." There is, however, no information available as to the exact method followed in getting a population count from the 50-line pages of the 1900 schedule through the use of the Hollerith tabulating machine. The method followed in 1890, as described on page 61, above[5] could hardly have been used, since the 1900 schedule did not show in convenient form the number of persons in each family, as the 1890 schedule did; and the 1900 count was presumably limited to a count of population, since the family data published in Volume II of the 1900 reports were obtained, along with data on color, sex, and age of family heads, from a tabulation of the family card.

[5] The 1890 procedure provided not only a count of the population but also counts of dwellings and families under various classifications.

Digitized by Google

The count of dwellings and families, which was obtained in 1890 as a part of the preliminary count direct from the schedule, was secured in 1900 much later, from the special family card just mentioned, which was punched and partly tabulated after the completion of the work on the population card.

The task of punching the 1900 population data on the pantograph punch was somewhat different, by reason of the different form of the schedule—presumably much easier, with the schedule holder designed for this purpose. This holder, as already indicated, was in the form of a large cylinder, with guidelines which permitted the operator to see only the line that was being punched, whereas in 1890 the figures had to be selected, by question number, from entries in a rather wide column.

The population card was redesigned, as indicated below, so as to make the machine wiring much simpler in many cases, and to facilitate sorting, though some of these changes placed a heavier burden on the puncher, that is, required him to think about relationships, etc., rather than punching exactly what was written on the schedule.

The schedule.—The population schedule for 1900 was printed on a sheet 18½ inches wide and 19 inches deep, with 50 lines on each side of the sheet, or 100 lines in all. The lines were numbered from 1 to 100. The columns from which data were punched in the card for tabulation, which were also numbered, carried the following headings:

5. Color or race
6. Sex
7. Date of birth; used for confirmation of reported age
8. Age at last birthday (in distinction from age at nearest birthday, as in 1890)
9. Conjugal condition
10. Years married; used to distinguish between "Less than 1 year," and "1 year or more"—punched "M0," or "M1")
11. Mother of how many children
12. Number of these children living
13. Place of birth of person
14. Place of birth of father
15. Place of birth of mother
16. Year of immigration to the United States; used for confirmation of years in the United States
17. Years in the United States
19. Occupation
20. Months unemployed
21. Attended school, months
22. Can read
23. Can write
24. Can speak English
25. Home owned or rented
26. Owned free or mortgaged
27. Farm or home
28. Number of farm schedule; used for confirmation of answer "farm"

Digitized by Google

Questions 25–27 were omitted from the population card, but punched in the family card, to be noted later.

Identification of card with schedule.—The cards, completely printed, as illustrated below, were numbered, in advance of punching, with a double set of numbers, indicating sheet and line, as follows:

01 01, sheet 1, line 1
01 02, sheet 1, line 2
Etc.

The object of these numbers was to make it possible to identify each card (when punched) with the sheet and line of the schedule, in order to verify the record as shown on the punched card. The process of identification was much simpler than that required for the 1890 cards (see page 59, above), by reason of the different form of the schedule.

In beginning the work of punching for an enumeration district the punching clerk entered the number of the first card at the top of the first page of the first schedule in the ED. Note that this number had to be distinguished from the schedule number previously entered by the enumerator, which already appeared in the heading of the schedule. If there were blank lines in the body of the schedule, or unused lines at the end of the ED, the cards corresponding to these line numbers were discarded.

The 1900 population card.—The 1900 population cards, as they were delivered to the punching clerks, were printed as shown in figure 31 (unpunched) and figure 32 (completely punched).

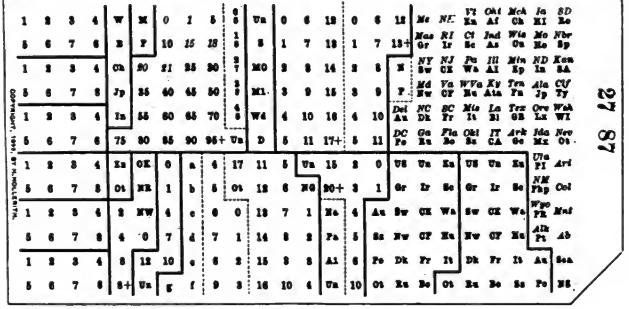


FIGURE 31.—Population card for 1900, unpunched

This card form may be compared with the outline of the 1890 card, as taken from the reading board and shown in figure 16, above. The

Digitized by Google

general arrangement of the fields was similar, running across the top of the card from left to right, and then back, across the bottom of the card from right to left. Significant changes in specific fields will be commented on later. The six fields, one below the other, at the left of the first vertical line, were for identification of the geographic area; they were punched on the gang punch (see figure 14), after the keyboard punching for an ED was completed.

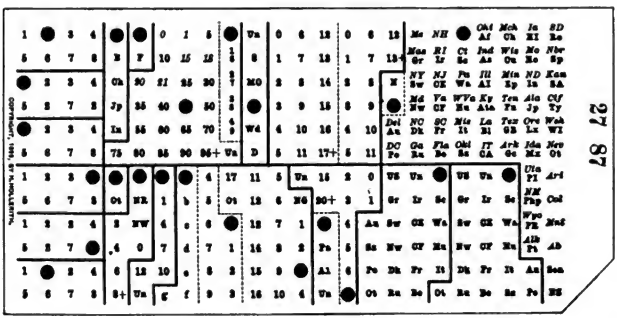


FIGURE 32.—Population card for 1900, completely punched. This card represents a white male, married, born in England, both parents born in England, in the United States 10 years, naturalized, a teacher by profession, not unemployed in census year, able to read, write, and speak English; resident in Ward 8, of Albany, N. Y.

Punching the card.—The details of the punching may be represented by the following quotations, slightly condensed, from the punching clerks' instructions:

In the first field punch color or race from col. 5 of the schedule, and in the second, punch sex from col. 6. In the third field, punch from col. 8 first the period (usually a 5-year period) in which the age occurred, represented on the card by the first year in the period, then, in the small inset field, the unit within that group, thus, for age 27, punch "25" for age period 25–29, then "2/7" ("2" or "7") for the final digit.

In the next field punch conjugal condition from cols. 9 and 10, "S" for single; "M0" for married less than 1 year; "M1" for married 1 year or more; "Wd" for widowed, and "D" for divorced.

In the next field, for women only, punch the number of children the woman has had, from col. 11, and in the next, the number of children living, from col. 12.

Next, in the little 2-position field, either "N" for native or "F" for foreign born, according to the birthplace reported, whether a State or territory or a foreign country; then the specific State or country of birth, as returned in col. 13, using the "Index to Place of Birth, etc." where necessary. Note that the upper symbol printed in the any punch position indicates the State of birth, for a native person, and the lower the country, for a foreign-born person.

Digitized by Google

In the next two fields, starting back along the bottom of the card, punch the place of birth of the person's father and mother, as recorded in cols. 14 and 15. If any State or territory is given as place of birth of father or mother, punch "US"; for father or mother born in a foreign country, punch the country if it is shown in the Index; otherwise, punch "Ot" for other country.

In the main part of the next field, just to the left of the field for country of birth of mother, punch, first, for foreign born only, the number of years in the United States from col. 17; and in the little inset field the symbol for citizenship status—"Na" for naturalized, "Pa" for first papers, "Al" for alien, or "Un" for unknown or not reported. [There is some indication that in practice these symbols were punched only for males 21 and over.]

In the next field, punch the occupation returned in col. 19, using the code number given in the occupation list provided (a list containing code numbers which covered about three-quarters of the whole number of gainful workers); or if the occupation is not listed, punch "Ot." [The cards punched "Ot" were later sorted back to schedule order, the missing occupations were coded, and the occupations punched into the cards, prior to the occupation count.] For all persons reported as attending school, and for all others for whom no occupation is given, punch "NG," not gainfully employed.

In the little field at the left of the lettered section of the occupation field, punch for a person with an occupation the number of months unemployed, from col. 20. For persons without occupation, punched "NG" in the first occupation field, leave this field blank.

In the next field, punch the number of months attending school, if any, as reported in col. 21, and pay no attention to the letters in the top of the field. But for all persons not attending school, punch in accordance with the replies in cols. 23 and 24; for No–No, punch "NR," not able to read or write; for Yes–No, punch "NW," not able to write; for Yes–Yes, *or for no return*, punch "OK."

Finally, in the tiny field at the left of the literacy symbols, punch "Ot" for a person not able to speak English, as returned in col. 24; and for all others, including those with no return, punch "En."

Changes in card between 1890 and 1900.—The first point of difference between the 1890 card and that used in 1900 was the omission of the symbols for veteran status; the question on this point was not asked in 1900. (Compare the 1900 card, as presented in figure 31, with the outline of the 1890 card in figure 16.)

Next is the omission of the symbols for relationship to head of family; these items were reserved, in 1900, for the family card.

The field for color or race was retained, but simplified by substituting a single "B" in place of the four symbols for black, mulatto, quadroon, and octaroon of 1890.

The symbols for sex were placed more conveniently at the top of the card; and the symbols for age were rearranged reading in lines rather than in columns, with the symbol "0" for persons under 1, with age given in months; two of the 5-year periods were split, to simplify the wiring for certain tabulations, namely, 15–19, split into 15–17 and 18–19, and 20–24, split into 20 and 21–24; and alternative final digits, 0/5, 1/6, etc., were printed in the units field.

The field for conjugal condition was unchanged, except for the substitution of "M0" (married less than one year) for "CY" (married

Digitized by Google

in the census year), and a corresponding change from "Mr" to M1" (married 1 year or more).

The fields for children born and living were simplified so as to call for double punching only for the larger numbers.

The most important change, at least from the point of view of the electrician who had to wire the tabulating machine, was the introduction of a single symbol for native and one for foreign born. This eliminated the cumbersome tying together of groups of place-of-birth symbols to handle these fundamental classifications. Note, incidentally, however, that this change added one more point on which the *puncher* had to do some thinking and deciding.

Next the use of code symbols for place of birth was completely eliminated (perhaps an offset to the puncher for the burden of deciding whether native or foreign born), and each place of birth was given a position on the card—these being used once for States, for cards already punched "N," native, and again for countries, for cards punched "F," foreign born. The 1890 symbol "St," for birth in State of residence, was omitted—saving much complexity in the tabulation program.

The fields for country of birth of father and mother were made a little larger by the addition of three countries.

The fields for years in the United States and citizenship were slightly different in form but not substantially changed.

The field for occupation was set up in three sections rather than two and the codes were expressed mainly in figures, probably a little easier to handle than the 2-letter symbols of 1890.

The last three fields, covering school attendance, illiteracy, and ability to speak English, were practically unchanged, except that the last was reduced to the two significant positions, "En," able to speak English, and "Ot," not able to speak English.

The verification run.—The first run of the 1900 cards was made for the purpose of eliminating errors in punching and erroneous or doubtful returns on the schedule. Perhaps the simplest sort of error which the Hollerith machine could detect was the failure to punch any hole whatever in an entire field. If the entire field for color, for example, was left unpunched the card would fail to register and therefore fail to ring the bell for which the operator was listening. Cards were also rejected if they were "off gauge" or otherwise mechanically defective.[6] These rejected cards were examined and the omitted items supplied—or new cards, conforming to the mechanical requirements, were punched.

In addition to these defective cards, there were many cards containing items that were so far inconsistent as to raise questions with respect to

[6] A card was considered "off gauge" either if it was even a little too large or too small, or, as more often happened, if the holes were not in exactly the right position.

Digitized by Google

the accuracy either of the punching or of the original returns from which they were punched. The verification run of 1900 was designed to take care of both types of defective cards, in advance of the use of the cards in final tabulations, through a special machine wired to reject not only incomplete or defective cards, but also those with specified inconsistent items, items otherwise frequently subject to question of accuracy, and a considerable number of items of infrequent occurrence, of which it was desired to be doubly certain.

The rejected cards were sorted back to schedule order and compared with the schedule from which they were punched. Omitted items were supplied; doubtful items, like age 95-plus, were examined and either corrected or allowed to stand, in accordance with the best interpretation of all the information on the schedule; and items considered utterly inconsistent, like 6-year-old children reported as married, were corrected.

In the light of present-day acceptance of the possibility of error, even in major classifications, the 1900 verification program would seem to go much farther than necessary, especially in the rejection and checking back to schedule of items rejected simply because they were of infrequent occurrence—like extreme ages and such scattered color returns as Chinese or Japanese. In particular, the rejection and checking of all "native black" in northern States and all foreign-born white in southern States would seem to be an unreasonable expenditure of labor. This meticulous checking back to schedule was gradually reduced in later censuses,[7] until by 1940, it had practically disappeared, being partly replaced, perhaps, by improvement in the editing of the schedules before they were punched and other devices for assuring accuracy. There is available, however, a copy of the printed instructions for verification of the 1900 population card covering all points listed in the summary statement below. By reason of the large number of combinations involved, the wiring of the machine for the verification run was far more complicated than that required for any of the actual counts—either of the 1890 counts outlined above or of the generally simpler counts made in 1900. By reason of the stress placed upon this part of the tabulation procedure in the early days, as contrasted with its almost complete omission at the present time, the instructions for rejecting cards with possibly questionable items for checking against the schedule are reproduced, with slight condensation, as follows:

In addition to cards rejected by the machine on account of omissions in one or more fields, cards are rejected for *verification*, as follows:

Color or race.—Foreign black cards are always rejected.

Chinese, Japanese, and *Indian* cards are always rejected. These four elements are to be verified to schedule and sorted, as foreign black, native Chinese, native Japanese,

[7] But note the verification program followed in 1920, p. 148, below.

Digitized by Google

native Indian, foreign Chinese, foreign Japanese, and foreign Indian, and set off by separation cards.

Native black cards are to be rejected in the North Atlantic, North Central, and Western Divisions and also in West Virginia and Oklahoma. (Note.—These cards can be counted, if desired, by using switch 6.)

Foreign white cards are rejected in the South Atlantic and South Central Divisions and also in Indiana and New Mexico. (Note.—These cards can be counted, if desired, by using switch 5.)

Age at last birthday.—Cards punched "90," "95-plus," and "Un" are always rejected. For the first two of these groups, a duplicate card is to be made, for use in a special investigation. Cards punched "Un" are carefully verified to schedule and if schedule reveals approximate age it is to be supplied by the correction clerk (if so directed).

Conjugal condition.—Cards for males under 21 years of age and for females under 18 punched as married (M0, M1), widowed (Wd), divorced (D), or unknown (Un) are always rejected for verification.

Children and children living.—Cards punched for married, widowed, or divorced women with 10 or more children are always rejected.

Cards punched for single women with 1 or more children are always rejected.

Place of birth.—Cards for *native* (N) persons punched Ab (American citizen born abroad), Sea (born at sea under U.S. flag), or NS (U.S. not specified) are always rejected.

Parentage.—Cards for *foreign-born* (F) persons with either "US" father (US, Un, or foreign mother) or "Un" father and "US" mother, are always rejected.

Foreign born persons with either a native (US) father or an "unknown" (Un) father and a native (US) mother should be properly classed as native (N) and punched "Ab" (American citizen born abroad), unless the schedule furnishes contrary evidence.

Citizenship. Cards for *foreign born* (F) persons without citizenship (that is, nothing punched for "Years in the U.S." or for "Naturalization" (one or both) are always rejected.

Occupations.—Cards for males and females under 15 years of age punched other than "NG" are always rejected. [Cards for persons 10–14 with occupation punched were finally accepted as gainful workers, unless contrary evidence appeared on the schedule.]

Cards for females punched "2, 3, 4, 5, 6 or 7" in "units" field of occupation codes (second or middle section on the card) are always rejected. These "unit" numbers are given to occupations not ordinarily followed by females and all cards so punched are to be verified.

Cards for males punched either "8 or 9" in "units" field of occupation code are always to be rejected. These numbers are given to occupations ordinarily followed by females, and all cards so punched for males are to be verified.

Months not employed.—Cards punched 12 months not employed are always rejected.

School attendance.—Cards for persons under 5 years of age and over 24 years of age punched with months of school attendance are always rejected.

English.—Cards for *native* (N) persons 10 years of age or over punched "Ot" for language are always rejected.

The machine setup for the verification run presumably had a small number of counters to register the population by color or race, in addition to a counter for the total number of cards handled. This would make available preliminary figures by race. (Certainly, the verification run used in 1920 was thus provided; and these verification machine sheets provided a useful source for color-sex data for townships and even for enumeration districts.)

Digitized by Google

MACHINE TABULATION, POPULATION, 1900

With respect to the tabulation program of the 1900 census it is possible to speak with some degree of confidence since there is available almost a complete set of the printed result slips used in recording the readings for the various counts or "runs" of the cards. Even the sorts under which the cards were arranged for each run are for the most part specified in the headings of the result slips. These are summarized in the following paragraphs; and two of the result slips are illustrated to show the exact form in which the data were taken off the machine—a form devised primarily, it would seem, to make it easy for the machine operator, with not too much effort to simplify the task of consolidation. Note that the letters used to designate the several counts do not make a continuous series; but they do cover the whole field of data published.

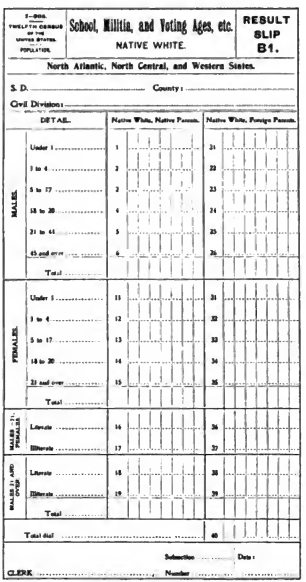


FIGURE 33.—Result slip for count B, 1900. Actual size 5½ by 10¼ inches

Count B—School, militia, and voting age, etc.—For this first count the cards for ED's were consolidated into larger packs, representing each urban place of 2,500 or more and the balance of the county.

Digitized by Google

Then the cards were sorted into the full detail of color or race, by nativity. Some of the sorting for the less numerous groups was done by hand in connection with the verification run, and the major classes were presumably established through the use of the sorting box in connection with that run. The cards were *not* sorted by sex at the start, as in 1890 and in censuses subsequent to 1900.

A separate form of printed result slip was provided for each of the color-nativity classes. The form for the native classes outside the South is illustrated in figure 33, which indicates the distribution of the 31 counters used. For the southern States there was added a third column for native Negroes, using counters 1–19, these to be recorded on the same sheet with the native white. For the foreign born the counters for literacy were further subdivided in accordance with citizenship or naturalization status.

Practically all the data resulting from this count were published, at least by States, and, with reasonable condensation, by counties and for places of 2,500 or over.[8]

Count D—State or territory of birth.—For this count, the native cards alone were consolidated from counties into Supervisors' Districts (SD's), while the foreign-born cards were laid aside for count E. An SD comprised a group of counties, but usually not a whole State. The smaller urban places were merged in this consolidation, which retained only those of 25,000 or over. (The grouping of counties into SD's was purely for convenience in administration; no figures were published for these areas.)

For this count, according to printed result slips (blank) found in the files, the cards for native white and "native black" were sorted by parentage, presumably through the use of the sorting box in connection with count B, and each class was also sorted into the following groups: (1) males under 21 years of age; (2) males 21 years old and over; and (3) females.

For each of the resulting nine major sort groups there was a separate printed result slip; and provision was made for recording the few foreign parentage Negroes on a general purpose sheet, along with the small numbers of Chinese, Japanese, and Indians.

On the tabulating machine, counters were set up for 33 States and for 6 combinations of symbols whose use is not quite clear. See illustration of result slip, D–2, both front and back, figure 34. The cards for other States were rejected, counted by hand (presumably on the completion of the tabulation area) and entered on the back of the result slip.

---

[8] *Twelfth Census of the United States, 1900*, Vol. I, Population, Pt. I, chapters on Sex, General Nativity, and Color, and Citizenship and Years in the United States; Pt. II, chapters on School, Militia, and Voting Ages, and Illiteracy.

Digitized by Google

In the published tables on State of birth [9] there is no classification by sex or by age, not even under and over 21. The figures for total native population classified by color, nativity, and parentage (for white only) which were published were probably obtained by consolidation from the tabulation outlined above, like many other published tables which omitted much of the tabulated detail. In this case, however, one may suggest that the published figures could have been obtained from a tabulation simplified by omitting the last sort (by sex and age periods), to the saving of a large amount of consolidation work and of the additional work of recording three times as many machine readings.

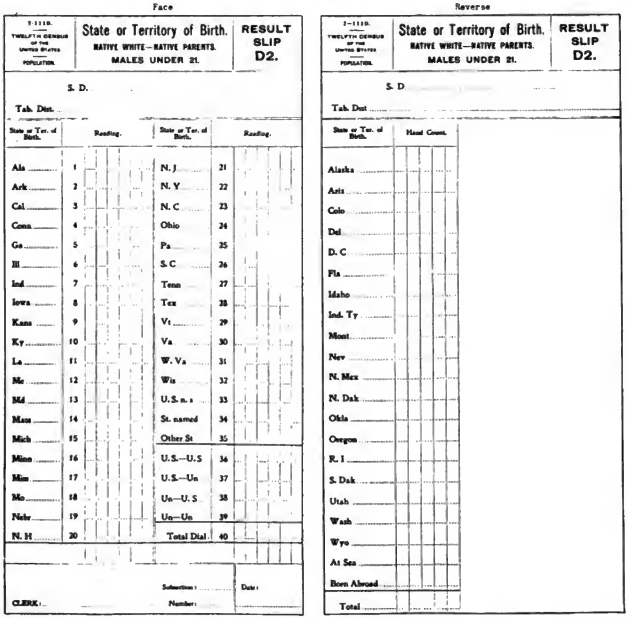


FIGURE 34.—Result slip for count D, 1900

Count E—Country of birth.—For this count the cards for foreign born, as they came from count B, were consolidated into counties, with separate packs for the larger cities only (25,000 or over), thus keeping somewhat more geographic detail than for the native cards used in count D (State of birth).

[9] *Twelfth Census of the United States, 1900*, Vol. I, Population, Pt. I, pp. 675–730.

Digitized by Google

Result slips are extant only for foreign-born white, but the tabulation must have been made for the foreign-born colored as well, since the presentation of data on country of birth in the 1900 report [10] is entirely on the basis of total foreign born, with no figure whatever for the foreign-born white alone (as one accustomed to later statistics of foreign stock might expect).

According to the printed result slips (blank forms; no actual completed slips were preserved), the foreign-born cards were sorted, as indicated for the cards for State of birth of the native population, into three sex-age groups, with a further sort by citizenship for the males 21 and over, thus:

Males under 21 years of age
Males 21 and over
  Naturalized
  First papers
  Alien
  Unknown
Females

There was a separate printed result slip for each of these six sort groups; and a general purpose sheet was provided on which to record the foreign-born colored classes.

The tabulating machine was wired to count 38 specific countries of birth, with an "All other" for specified other countries, but set so as to reject still other countries, including 11 countries listed on the back of the result slip for hand counting. In the relation between the counters and the complete list of countries, this count was similar to the tabulation of State of birth for the native population, including provision for the hand counting of rejected cards for minor countries.

Here, again, the published tables cover only a small part of the detail outlined in the tabulation forms. In fact, the data published in the chapter on country of birth are limited strictly to a simple classification by country of birth, with no separate figures even for white and colored, though one must assume that the color classes were kept separate in tabulation, since succeeding tabulations called for a sort of the cards by color. In the chapter on citizenship, etc., however, there are figures for males 21 and over and for aliens, by country of birth, which would not have been available if any considerable condensation of the sort for this count had been made.

Count H—Years in the United States.—For this count the foreign-born cards kept separate by counties for count E were consolidated, so that the only geographic areas shown were cities of 25,000 or over and the balance of the State. These areas were used for all the remaining counts.

[10] *Twelfth Census of the United States, 1900*, Vol. I, Population, Pt. 1 (1901), pp. 731–804 and 915–921.

Digitized by Google

This count was made for foreign-born persons in the three sex-age groups specified for counts D and E, again with the males 21 and over subsorted by citizenship or naturalization status.

The tabulating machine was wired to count years in the United States—single years from 1 to 5, then groups ending with 20 years and over, plus ability to speak English on 2 counters. Persons under 10 years of age were counted separately, but even with this classification the machine used only 32 counters, with only one simple set of relays.

The result slips at hand cover only foreign-born white; but the data published in the 1900 report represent total foreign born, so one must assume similar tabulations for the various classes of foreign-born colored. Specifically, tables showing years in the United States were published for foreign-born males, foreign-born females, foreign-born males 21 and over, and alien males 21 and over.[11]

For males 21 and over, sorted by citizenship, the result slip contained only the second section of the result slip just outlined, namely, the column of years in the United States, with the counters for ability to speak English.

Count K—Birthplace of parents.—This count, made for the larger geographic areas indicated for count H, was a tabulation of population by birthplace of father and mother, in detail similar to that of 1890, except with a more inclusive list of countries—30 in all, including the United States, as indicated by a single page of the posting sheet, which is the only printed tabulation form now available for this subject. For publication, the list of countries was condensed to about 20. The posting sheet indicates an overall sort by "general nativity and color," presumably native white, foreign-born white, Negro, and other colored, and then by birthplace of father, with stub items for the sex-age-citizenship sorts of counts D and E, and counters for country of birth of mother.

Only a part of the detail derived from this tabulation is published in the report.[12] From the basic sort, there are figures for total white and colored, for native white, and for foreign-born white, but no classification by age or sex (or citizenship). One might, therefore, venture to suggest that, as in the case of count D, this sort might well have been omitted from the actual tabulation, in order to save both tabulation time and the labor of consolidating figures spread over at least six sets of result slips, to get the data actually published.

Count L—Age detail, conjugal condition, etc.—For this count the cards for native whites were sorted by parentage; that is, as of native parentage (both parents native) or foreign parentage (one or both parents foreign born), and the classification of males as under 21 and 21

[11] *Twelfth Census of the United States, 1900*, Vol. I, Population, Pt. I (1901), pp. 924 ff.
[12] *Twelfth Census of the United States, 1900*, Vol. I, Population, Pt. I, pp. 805–905.

Digitized by Google

or over was discarded. The colored were tabulated as Negro and other colored, without regard for nativity. Then, all classes were sorted into 5-year age periods, presumably through the use of the sorting box in connection with the preceding runs; that is, they were sorted on the major age field of the card, so that all items counted would be cross-classified by age in 5-year periods; and the first period was subsorted by single years, to give single years from 0 to 4.

For each color-nativity-sex group there was a set of six result slips containing columns for readings; first, five columns for the first five single years, then columns for successive 5-year periods, winding up with 100-plus and Unknown.

Thirty-seven counters on the dial board were used, distributed as follows:

	Counters
Age detail, single years within period, from the units field on the card	1–5
Country of birth of mother	6–20

This made page 1 of the result slip; then on the reverse, page 2:

	Counters
Illiteracy and school attendance, exactly as punched on the card	21–28
English, yes or no	29–30
Conjugal condition,[13] as punched on the card	31–36
Total number of cards	40

The results of this very detailed tabulation provided most of the material for the first half of Volume II of the 1900 Reports on Population. All of the classifications provided on the result slip were used in some form, albeit often with extensive condensation, especially in the matter of age periods. The data on country of birth of mother were tabulated for the use of the Division of Vital Statistics and thus were not included in the Population Reports.

The occupation count.—The statistics on occupation published in the "regular" 1900 reports[14] were limited to a list of 303 occupations, by sex, for States and cities of 25,000 or more. From the cards, as sorted by occupation, were tabulated later the material published in a Special Report on Occupations,[15] which was completed before the end of 1903. For these tabulations the cards were first consolidated into 140 occupation groups and then run on machines wired to show the desired cross-classifications.

For this special report the data for persons 10 years old and over reporting an occupation (termed "gainful workers") were tabulated under nearly all the classifications shown for the general population

[13] But note that the figures for persons married less than 1 year and 1 year or more were not separately published in the report. *Twelfth Census of the United States, 1900*, Vol. I, Population, Pt. 1 (1901), conjugal condition, pp. 251–348.

[14] *Twelfth Census of the United States, 1900*, Vol. II, Population, Pt. II (1902), pp. 503–601.

[15] *Twelfth Census of the United States, 1900*, Special Reports, Occupations (1904).

Digitized by Google

except the detailed combinations of country of birth of father and mother.

The tabulations must have been done for States and cities of 50,000 or more, though the figures were much condensed in publication for areas less than the United States as a whole. Provisionally, one may assume that the cards for each of the 140 occupation groups, already sorted by sex, were sorted into five color-nativity groups as follows:

Native white, native parentage
Native white, foreign parentage
Foreign-born white
Negro
Other races (Chinese, Japanese, and Indian)

This would make 10 packs of cards for each of the 140 occupations in a large city, or in the balance of the State. The publication for the colored was in the form of a line (or column) for total colored, followed by a line for Negro.

Most of the cross-classifications presented in the special report could have been obtained by running the cards as thus sorted on one machine set up for age groups, 10-year groups from 15 to 65, with single years for ages from 10 to 14; conjugal condition; and period of unemployment (3 periods: 1–3 months, 4–6 months, and 7–12 months). Then, for the material on place of birth of parents, the color-nativity packs could have been thrown together, making 2 packs only for each occupation, and run on a second machine set up to count 21 countries of birth of parents. For this count persons with both parents born in the same foreign country, or with one parent born in that country and one native, were combined under the name of that specific country, with a residual group for all persons of "mixed foreign parentage."

Neither of these machines would use the capacity of the dial board to its limit; but it would hardly have been practicable to set up one machine to handle all of the items assigned to these two machines; and it would not have been economical to tabulate place of birth of parents for the cards sorted into five color-nativity groups, since the color-nativity classification was not called for in this connection.

THE 1900 CENSUS OF AGRICULTURE

Special attention was given to the planning of the tabulation of the results of the census of agriculture, in view of the admitted inadequacy of the 1890 reports on this subject. In justification for this emphasis, Director Merriam quoted the numbers of gainful workers employed in agriculture and in other broad sections of economic activity in 1890, as follows: In agriculture, over 8 million; in manufactures and mechanical industries, 5 million, and in trade and transporatation, 3,300,000. Looking forward to the future, he made this statement: "It is submitted

Digitized by Google

that agriculture always has been and always will be the most important industry of the Republic." [16]

The schedule.—The 1900 schedule for the census of agriculture was printed in the form of a 4-page folder, with instructions on page 1 and 153 items or questions on pages 2, 3, and 4. Some of the items, however, called for as many as three answers, as for example, the question on corn, under which were reported acreage, production, and value. In general content and arrangement, the schedule was not radically different from the schedules used in recent farm censuses.

The first process, following the receipt of the schedules, was termed editing. This included a general examination of the schedules for completeness and consistency, the entering of directive symbols for the use of the card punchers in connection with certain questions, and the entering, in the margin of the schedule, of symbols indicating tenure, color or race of operator, brief classifications of the farm by size, value of products, and principal source of income. The symbols for the size classification were based on the reported acreage and were provided, in addition to the specific acreage, as a convenient means of grouping the cards for the larger and smaller farms for cross-classification with other items. The "principal source of income" was that product or group of products which furnished 40 percent or more of the total value of products. The editing process, as reported about midway in the progress of the work, consumed something over 6 minutes per schedule.

The 1900 farm card.—Two cards were used for the 1900 census of agriculture. The farm card, so called because there was one card for each farm, was somewhat larger than the population card, being 7¾ inches by 3¼ inches, and had 36 columns, each 3/16 of an inch wide, as compared with 24 ¼-inch columns on the population card. All of the 36 columns were punched on the key punch, already described and illustrated above (figure 30).

In addition to the fields, each made up of one or more columns, in the main part of the card, provision was made for State and county symbols, and also for color and tenure of operator, in the top margin. These marginal items were punched on a gang punch similar to that used for the population cards, as illustrated in figure 14, except that it provided for the insertion of the whole card, rather than just the left-hand end. The inclusion of the color-tenure items on the gang punch required that the cards come to the gang punch operator already sorted by color and tenure.

To make this possible the *schedules* were sorted by color, usually two items, but occasionally, where there were Indian or Chinese farmers, three or four; and then by tenure, usually six items, though sometimes fewer in areas where some of the tenures were not represented. Thus, for each county there would be normally 12 packages of schedules, representing the color-tenure groups, but now and then a larger or

[16] *Report of the Director of the Twelfth Census*, November 1, 1900, p. 18.

Digitized by Google

smaller number, necessitating a close check on the sorting and on the recording of the work as it passed through the various processes.

Since it was far easier to sort cards than to sort schedules, even before the advent of the electric sorting machine, this procedure would seem to discard one of the advantages of the punch card method. And in addition, it left the schedules for a county filed in 12 (or more) subdivisions, rather than in one simple numerical series, for later reference. Nevertheless, H. T. Newcomb, at one time administrative assistant to the chief of the Agriculture Division, wrote, in 1901,[17] "In order to make it possible to utilize the more economical gang punch, the schedules . . . are assorted . . . in 12 classes according to . . . race . . . and tenure" before punching. In addition to the more difficult sorting of the schedules, there were 12 times as many packs of cards to handle and keep separate between key punching and gang punching, and 12 times as many settings of the gang punch—this in itself more than offsetting the added task of punching two more items on the key punch.

The printed form of the farm card is shown in figures 35 and 36, first the unpunched card, with the addition of overprinted words indicating the item to be punched in each field, and second, a completely punched card.

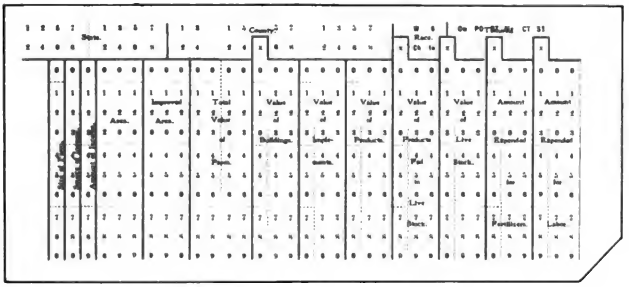


FIGURE 35.—Farm card, unpunched

Note that the fields are composed of one or more complete columns, as required for use on the 11-key punch, rather than of irregular blocks, as on the population card.

The two blank columns at the left of the card were used, in certain States, in connection with range farms and with irrigation, as follows:

For a schedule on which the word "Range" was stamped, in red, a "1" was punched in the extreme left margin of the card, under the "2" in the X line; and for a schedule reporting irrigated crops, as indicated by

[17] H. T. Newcomb, *Mechanical Tabulation of the Statistics of Agriculture (1900)*, a paper presented to the AAAS at Denver, in August 1901, and also published in Philadelphia as a separate pamphlet, p. 20.

Digitized by Google

the answers in questions 17 or 18, a "1" was punched in the second of these marginal blank columns, under the "4" in the X line. In these States, for farms with no range land a zero was punched in place of the "1" in the first column; and for farms with no irrigation, a zero in the second of these columns.

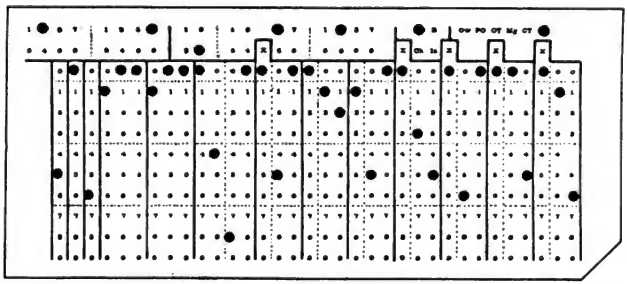


FIGURE 36.—Farm card completely punched. This card represents a farm of 100 acres, located in Shiawassee County, Michigan, and operated by a white farmer who held the land as a tenant, paying a share of the products to his landlord. On June 1, 1900, the entire farm was made up of improved land; its aggregate value was $4,800, including buildings worth $500; implements and machinery worth $120 were used in its cultivation; products raised during the crop year of 1899 were worth $1,500, of which $350 worth were fed to livestock on the farm; $50 was expended for fertilizer during the crop year, and $160 for labor. Note that the units digit has been omitted in punching the figures for value.

For purposes of classification of various items according to size of farm, the following groups were established, each group represented by a symbol written by the schedule editor in the left margin of page 2 of the schedule and punched in the first narrow printed column on the card.

0. Under 3 acres
1. 3 to 9 acres
2. 10 to 19 acres
3. 20 to 49 acres
4. 50 to 99 acres
5. 100 to 174 acres
6. 175 to 259 acres
7. 260 to 499 acres
8. 500 to 999 acres
9. 1,000 acres or more

In the second of these narrow columns was punched a second symbol, also written in the margin of the schedule, indicating the principal source of farm income, the major classes being as follows:

0. Hay and grain
1. Vegetables
2. Fruits
3. Livestock
4. Dairy products
5. Tobacco
6. Cotton
7. Rice
8. Sugar
9. Other products

Digitized by Google

In the third narrow column was punched a symbol indicating one of the established classes based on the value of all products, excluding crops fed to livestock, a figure sometimes termed, as on the card, "amount of income."[18] These symbols were as follows:

0. $0
1. $1 to $49
2. $50 to $99
3. $100 to $249
4. $250 to $499
5. $500 to $999
6. $1,000 to $2,499
7. $2,500 or more

In the remaining broader fields of the card were punched the following quantitative items:

4. Area, in acres
5. Improved acreage
6. Total value of farm, in dollars
7. Value of buildings
8. Value of implements and machinery
9. Value of products
10. Value of products fed to livestock
11. Value of livestock
12. Amount expended for fertilizer
13. Amount expended for labor

Except for items 4 and 5, as numbered above, the units digit of the figure reported was omitted and the tens digit was raised by 1 if the omitted digit was 6 or more—or every other time if it was exactly 5. This requirement doubtless added materially to the difficulty of doing accurate punching.

Supplementary cards with red ends were provided for cases where the space provided on the main card was not sufficient—for example, where the value of the farm was over $99,000.

The schedules were numbered (within a county) and each card was to carry the same number as the schedule.

The whole complicated and laborious proceeding outlined above for getting color and tenure punched on the gang punch could have been avoided by splitting the two initial (blank) columns each into two fields, one above the other (as in some cases on the population card) and punching color and tenure, as well as size of farm, source of income, etc., on the key punch at the start. Specifically, the "0" positions could have been used, as they were, to identify range land and irrigation; and six lower positions in these two columns could have been used, as two fields, respectively, for color and tenure. The lower fields could have been punched under the two-position fields for range and irrigation simply by pushing the carriage of the punch machine back to the left after punching the two upper positions—a device available, with this punch machine, only at the beginning (or the end) of the card. Then

[18] *Twelfth Census of the United States, 1900*, Vol. V, Agriculture, Pt. I, p. lix.

Digitized by Google

the *cards* could have been sorted by color and tenure, a much simpler process than sorting the schedules.

Thus the whole task of sorting the schedules by color and tenure and keeping the color-tenure packs separate for gang punching could have been avoided. The gang punch would then have recorded simply the geographic area, State and county, these representing the areas under which the schedules were normally filed. And the schedules for each county would have been filed in simple numerical order.

The classification items assigned to the upper margin of the card and gang punched along with the State and county symbols, were as follows:

Color:	Tenure:
W—White	Ow—Owner (full owner)
B—Negro	Po—Part owner
Ch—Chinese[19]	OT—Owner and tenant
In—Indian[19]	Mg—Manager
	CT—Cash tenant
	ST—Share tenant

These are the classifications which, as suggested above, might have been key punched in unused space in the lower part of the first two columns on the card.

The key punching of a farm card required from 24 to 34 key strokes, the average being much nearer the larger number. The average production per day at the end of August, 1901, was about 1,000 cards per operator, with a considerable increase as the punch operators became more experienced.

At the beginning of the punching, the work of each punch machine operator was verified until a satisfactory degree of accuracy was attained; then a certain number of cards were verified each week, to see that the standard of accuracy was being maintained.

Tabulating machine for the farm card.—The machine provided for the tabulation of the farm card was much more extensive than the population machine, since it comprised 10 separate adding devices, for accumulating totals from the 10 "quantitative" fields of the card, in addition to counters for the numbers of farms in various combinations of the classification codes punched in the left-hand section of the card—though the combinations required to be counted were relatively simple, since a large part of the classification was provided in the several sorts of the cards.

The illustration of the machines presented in figure 37 shows the 10 counters for recording the additions, expressed in actual digits, which were much easier to read than the clockface counters used for population; then, above these counters, 21 dials, like those on the population machines, for counting the numbers of farms in the various combinations of classifications.

[19] The whole number of farms returned as operated by Indians was 19,910, and by Chinese, 1,842, mainly in Hawaii and California.

Digitized by Google

That part of the tabulating machines used for the agriculture census which received the cards, usually termed the "press," was practically the same as that used in the population machine, as already described in detail above. And the method of recording the results, by reading the several dials or counters at the end of each run, was the same.

The cards, as they came from the gang punch, were already sorted by color (or race) and tenure; and since only three runs of the farm card were made,[20] one must assume that there was one further sort of the



FIGURE 37.—Tabulating machines for the farm card. Note both counters for acreage, etc., and dials for farm classification.

existing packs of cards, presumably by the size code punched in the first printed column of the card. This sort would make the result slips and the subsequent consolidations very complicated and voluminous. In fact, they would be so extremely voluminous, with a potential of 100 sort packs for each county, that one feels inclined to say that an additional run, with the cards sorted only by the size code, would have entailed less work. The tabulation of the quantitative columns under this combination sort would give all the classifications of acreage, value, or expenditures that appear in the published reports except those by principal source of income and value of products, and all the combination counts of farms except the cross-classification of these two series. A run

[20] *Report of the Director of the Twelfth Census, 1901*, p. 10.

Digitized by Google

of the cards sorted simply by source of income (consolidating the sorts by color and tenure) would provide the quantitative items under this classification, and with the addition of counters for the value of products, the final combinations of farm characteristics. And a third run of the cards, sorted on the value of products symbols alone, would complete the data shown in the reports for acreage, values, etc.

The three runs just referred to would be made with the farm cards sorted as follows:

No. 1. By color-tenure and size (around 80 or 100 packs per area)
No. 2. By principal source of income (10 packs per area)
No. 3. By value of products (7 packs per area)

The alternative proposed as probably more efficient would substitute for run No. 1, two simpler runs, with the cards sorted as follows:

No. 1–A. By color-tenure only (10 or 12 packs per area)
No. 1–B. By size only (9 packs per area)

Twelve machines were installed for the tabulation of the farm cards. The production record for June, 1901, was 5,483 cards per 6½-hour day; for 3 days in mid-July, the average was 7,159; and for the last week in August, 8,130. Considerable increase in the daily output was presumably attained in the succeeding months, as little more than one-quarter of the work had been completed at the end of August.

The 1900 crop card.—The second agriculture card, the crop card, so-called, was much smaller than the farm card, having only 16 columns, arranged in six "fields," with a gang punch field set up in ¼-inch squares, to fit the population gang punch. The dimensions of the card were ⅝ inches by 3¼ inches, though according to a sample found among the records there was an unused space 1⅜ inches wide on the right.

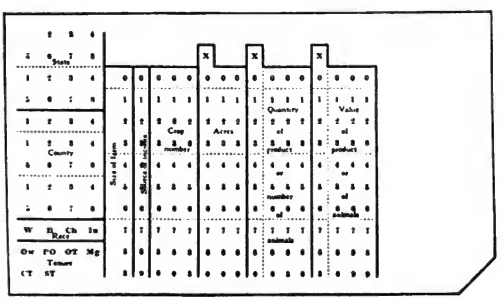


FIGURE 38.—Crop card, unpunched

Digitized by Google

The printed form of the crop card is shown in figures 38 and 39—both the blank card, with overprinted labels and a completely punched card. In the latter may be noted the larger size of the holes punched in the first four columns (on the population gang punch) and the smaller holes in the closer-spaced columns done on the agriculture key punch.

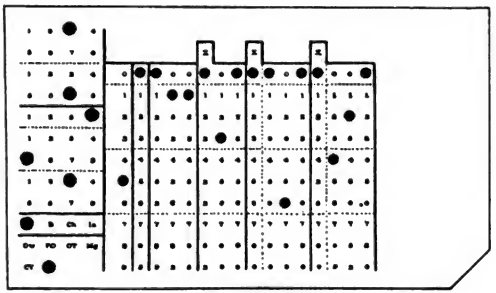


FIGURE 39.—Crop card, completely punched. This card represents the wheat (symbol 011, for wheat reported in bushels) grown on the farm represented by the farm card illustrated in figure 36. This crop was harvested from 30 acres, amounted to 600 bushels (units digit omitted) and was valued at $430.

The classifications by color or race of operator and tenure occupied three rows at the bottom of the gang punch section and were punched as a part of the gang punching operation. This would mean that the crop cards, like the farm cards, had to be kept in separate packs corresponding to the sort-groups of the schedules, for this operation.

Here again, even more easily than with the farm card, the labor of sorting the schedules prior to key punching (already done, of course, for the farm cards) and of keeping the color-tenure packs separate for the gang punch, could have been avoided, simply by providing, in the present gang punch space, key punch positions for color and tenure. Or still simpler, since the card has space for additional columns, by adding two full columns for color and tenure at the beginning, just preceding the present column for size of farm. Note that, even doing the sorting by hand or with the sorting needle, it is far easier to sort cards than schedules; and the labor of punching two more symbols on the key punch would have been relatively infinitesimal.

While there was ordinarily only one farm card per schedule, there were on the average about 20 crop cards for each farm, as one card was required for each crop reported, then one card for each of specified groups of livestock or livestock products, and additional cards for

Digitized by Google

miscellaneous questions assigned arbitrarily to crop cards, like acreage owned and rented, for part owners, or acres irrigated, or area under glass, for greenhouses, etc.

The specific crop or other item represented by a given card was indicated by a three-figure code punched in the first broad field, the different codes numbering about 300. For crops or products likely to be reported in different units by different farmers, two or more codes were provided; thus, the code for corn reported in bushels was 010, or for corn reported in hundredweights, 020; for cotton reported in square bales, 211; in round bales, 212; in pounds of seed cotton, 213; or in pounds of lint, 214, with still further codes, 217, 218, and 219, for Sea Island cotton reported in the respective units: 217 for pounds of lint, 218 for bales, and 219 for pounds in seed. (Note difference in order of units for Sea Island.)

Before punching the proper code for crop or livestock, however, the key punch operator had to punch the codes for size of farm and principal source of income, the same as on the farm card. These would be uniform, of course, for all cards punched from a given schedule.

For the crop card the provisions for omitting units or units and tens digits were much more complex than in the case of the farm card, since there was a much wider variety in the relative size of the items to be punched. Further, these instructions were more difficult to follow, since the omissions were prescribed for only one product here and there, and sometimes eliminated one digit and sometimes two.

Further, in a number of cases one code or another was used according to the presence or absence of figures for another item; for example, molasses reported in gallons on schedules also reporting sugar was coded 272, while on schedules not reporting sugar the code was 273. Again there were apparent inconsistencies; for example, in the general instructions for the livestock entries, the instructions read: "When there has been written an X before the name of an animal, punch three 0's in the field for acres. For all other animals for that field strike the X key." Red cards were used for range animals and for irrigated crops.

In most cases prenumbered cards were used, and the first number used was written on the schedule; and if red cards were used for range animals or irrigated crops, the numbers of these cards also were written on the schedules. Red-end cards were used for overflow items here, as with the farm cards; except that for overflow from red-card items there was provided a red-end card with the top margin colored green. These overflow cards were to bear the same numbers as the cards which they supplemented. All these special cases must have made the task very complicated, not only for the card punchers, but also for the tabulating machine operatives, and likewise for the clerks who translated the codes into titles or column headings for the tables.

Digitized by Google

Since the crop cards were prenumbered and tied in to the schedules through the writing on the schedule of the number of the first card only, the problem of checking a card back to the schedule for verification or correction must have been rather difficult—especially since the schedules were presumably filed in color-tenure groups rather than in a continuous series. Thus, first noting the color-tenure classification of the suspected card, one would leaf through the schedules under the corresponding classification to find a number approximating the card number and then hunt for a schedule that seemed to match the card item; then woe to the checker, if the error happened to be in the selection of the crop code!

The smaller crop card required at least 8 perforations, and frequently as many as 16, with an average around 13. A separate crop card was punched for each crop, one for each class of livestock, and some for miscellaneous inquiries on the schedule. The data for punching had to be taken from various parts of the schedule; different code numbers had to be identified and fitted to the returns, often two or three different code symbols for the same crop, according to the unit in which the production was returned (bushels or hundredweights for corn, for example); and there were differing rules for the omission of final digits to be applied in different cases. So while the number of holes to be punched in a card was much smaller than with the farm card, additional time and attention had to be paid to these varying specifications for handling the different parts of a given schedule. The production records showed an average of about 2,000 cards per day per operator, however, around the end of August, 1901.

Tabulating machine for crop cards.—The machine used for tabulating the crop cards was smaller than that provided for the farm cards, comprising simply three sets of the adding mechanism with a single clockface counter to register the total number of cards in the run. These machines, each with one clockface counter and three registers for totals, are illustrated in figure 40.

The crop cards were run more rapidly, since there were fewer totals to be taken off for each reading. The average production per machine during the month of June, 1901, was 8,104; in July, 9,595; and in August, 10,132, with presumably considerable increases over this last figure during the remaining months of the tabulation period.

The crop cards representing livestock and livestock products were tabulated first under the sort by color-tenure, as they came from the gang punch, then sorted by size of farm only, as punched in the first column of the card, and finally by principal source of farm income. Thus these cards were run through the machines three times, producing data under the three classifications listed, or four, counting color and tenure separately, as they were published.

Digitized by Google

The cards for the major crops were run through the machine twice, once as sorted by color-tenure (though the published figures appear only as classified by tenure and again by color of operator, not under the combined classification showing tenure by color), and again as sorted by size of farm.



FIGURE 40.—Tabulating machines for crop cards

The cards for the less important crops and for livestock and livestock products were apparently run through the machines only once; and the reports do not show any classification, not even color or tenure.

Evaluation of program.—Dr. L. G. Powers, Chief of the Agriculture Division in the censuses of 1900 and 1910, is reported to have said, after the close of the 1900 census, that the compilation of the 1900 statistics of agriculture in 1900 through the use of the Hollerith equipment had cost twice as much as it would have cost to do it by hand work and adding machines.[21]

It would seem, after a rather intensive review of the procedures, that a very great saving, though perhaps not amounting to as much as 50 percent, could have been made if the planning had been simplified and modified so as to take fuller advantage of the possibilities of the punch card technique. The additional time and trouble (and possibility of

[21] Testimony of Charles W. Spicer in the case of the Tabulating Machine Co. vs. E. Dana Durand before the Supreme Court of the District of Columbia, February 24, 1910.

Digitized by Google

error) that could have been saved by planning to sort the *cards* rather than the schedules by color and tenure has already been noted. The complex instructions required for the card punchers could have been greatly simplified by providing different cards for the different types of information that were all punched in the crop card. And the transfer of a bit more of the "judgment" tasks from the punchers back to the editors would have expedited the work and reduced the chance of serious errors. The task of punching cards ought to be reduced so far as possible to a matter of strict routine. Note comment above (p. 94) on the added burden imposed on the population card punchers by requiring that they punch "native" and "foreign born" by observing whether the birthplace was a State or a foreign country. Many of the fields on the crop card required similar "interpretations" on the part of the punch machine operator.

THE FAMILY CARD, 1900

A rather elaborate series of reports on families returned in the 1900 census was planned and a special family card was provided. In November of 1901 it was reported that more than 200 punching clerks were at work on this card, and that the punching for the entire country was expected to be finished by the end of January, 1902.[22] This card carried information on home tenure (which appeared on the individual card in 1890), number of families in the dwelling, number of persons in the family, number of persons in each of the relationship categories, and selected items of information about the head of the family. The specific items, each represented by a field on the family card, were as follows:

Fields relating to the dwelling or family—

1. Number of persons in the dwelling
2. Number of families in the dwelling
3. Type of family (private, hotel, etc.)
4. Number of persons in the family

5–9. Number in each of five relationship classes

Fields relating to the head of the family—

10. Color of head
11. Sex of head
12. Age of head
13. Age of head's wife (or husband, if female head)
14. Conjugal condition of head
15. Years married (for couples reported on schedule)
16. Nativity and parentage of head (a rather complicated code system giving country of birth for foreign born, and for native, country of birth of parents, if both of same country or one foreign and the other native)
17. Occupation of head

18–20. Occupational status of other members of family

21. Tenure of home (or farm)

[22] *Report of the Director of the Census for 1901*, p. 7.

Digitized by Google

The whole number of family cards punched amounted to 16,239,797.[23]

From these cards, the punching of which must have represented a very considerable cost, only one tabulation was made. At least the only figures relating to families which appear in the 1900 reports are those tabulated from the first four items on the card (numbers of persons and families in the dwelling, type of family, and number of persons in the family), and the tenure items from the last field on the card. These appear in the final section of the second volume of the population reports.[24]

A tabulation sheet (result slip T) had been prepared for the cards sorted by tenure and by color-nativity of head of family, to give sex and age of head and "country of origin"—country of birth of the foreign born (30 countries) and country of birth of foreign parent for native white of foreign or mixed parentage. This tabulation seems to have been dropped from the program for lack of funds for continuing the work.

PROPOSED TABULATION OF CHILDREN EVER BORN

Mention is made in the Director's Report dated July 15, 1903, of work looking forward to a tabulation of the data on children born and children living, these tabulations to be limited to women both of whose parents were born in the same country and whose husbands were living with them at the time of the census. These women were to be classified by color, nativity, parentage, age, and duration of marriage, with tabulation according to the number of children born and the number living. (No information is available with respect to the relationship to be established between these two figures.)

It was stated that (as of July, 1903) the sorting of the cards back to schedule order was four-fifths completed. The selection of cases, as well as the figure for years married, apparently required reference to the schedule. But here again the record stops with this reference to the preparation of the cards for tabulation. It is noted, in this same report,[25] that similar data for children born and living, collected in 1890, were actually punched in the cards for 1890, but by reason of the closing of the temporary census office, were not tabulated.

[23] W. R. Merriam, *op. cit.*, p. 841.

[24] *Twelfth Census of the United States, 1900*, Vol. II, Population, Pt. II (1902).

[25] *Report of the Director of the Census, 1903*, p. 5.

Digitized by Google

Chapter VI. THE CENSUS MACHINE SHOP AND THE 1910 CENSUS

DEVELOPMENTS IN THE CENSUS OFFICE, 1900—1910

Between 1900 and 1910 several important changes took place in the organization of the Census Office and its program of work. The most important of these were perhaps (1) the establishment of the Bureau of the Census as a permanent bureau (under the jurisdiction of the Department of Commerce and Labor), (2) the discontinuance of rental contracts with the Hollerith Co.—the Tabulating Machine Co., which later developed into the International Business Machines Corp. (IBM), and (3) the setting up of the Machine Shop (later called the Mechanical Laboratory), for the development and building of tabulation machinery to take the place of that previously operated on a rental basis.

Under the Permanent Census Bureau Act, the Bureau was organized, as before, into divisions nominally designated in accordance with major types of decennial census subject matter: Population, Agriculture, Vital Statistics, and Manufactures. There was to be, however, less rigid adherence to subject-matter specifications, so that almost the entire force might be assigned first to one and then to another of the various nondecennial projects.

One project undertaken in 1903 was the tabulation of the Census of the Philippine Islands, involving a population of 7,635,000, which was handled in the main by "regular" census employees—to the saving of funds for return to the Treasury, but at the expense of some other inquiries on which work had been discontinued for the time being, in order to complete this new assignment promptly. Two projects under way were temporarily suspended, in order to transfer clerks to the Philippine census, namely, Wealth, Debt, and Taxation, later completed, and the oft-interrupted work on fertility (children ever born) based on the 1900 census returns. This project, for which the major work (the punching of the cards) was well under way or possibly completed, was never taken up again. (Note that this was the second time that the material on this important subject had been collected and punched cards prepared, but no final tabulations made. See comment on 1890 situation, above, p. 83.)

Machinery used, 1902–1905.—During the early years of the decade, the rental of Hollerith machinery, mainly on the basis of rates per 1,000 cards handled, was continued. The tabulation machines used, after the completion of the 1900 census material, were the Hollerith automatic

Digitized by Google

tabulators, presumably similar to the one used briefly in 1902 and illustrated in figure 27, above. This machine used the familiar dial board, with space for 40 counters,[1] in conjunction with a reading head for the automatic feeding of the cards. This did away with the process of inserting the cards into the press one by one, but left to the operator the task of taking off the tabulated figures from the dials and then resetting the dials one by one.

For the Philippine census there were rented 8 automatic tabulating machines and 2 sorters,[2] obviously different from the 20 sorters used in the 1900 census of agriculture, which had been purchased by the Census Bureau and had not, at that time, been altered to handle the larger cards used for population work.

These automatic tabulating machines were used also in the tabulation of vital statistics. And in the Director's report dated July 15, 1903, there is recorded an interesting experiment in the extended use of the automatic tabulator for repeated tabulations of the cards, in place of the complicated consolidation sheets traditionally used to obtain data for the larger areas, as follows:

> The use of the automatic tabulating machine facilitates the counting of the cards to such a degree that it was determined to run the cards over and over again [consolidated into larger and larger areas] and to obtain by this process the aggregate tables that have heretofore been secured by a "hand consolidation" (that is, by drawing off the figures from one result slip after another and adding the columns). A test was made of the comparative time and cost of securing the aggregate tables in this way, and it was found that results which, as secured by hand-consolidation work in the preparation of certain tables for the regular census report, actually required 36,600 hours of work . . . costing $14,645, could be performed by 3 men using 3 automatic machines in 630 hours [a total of 1,890 hours] . . . at a total cost of $4,382, or about one-twentieth of the time and about one-third of the cost. In the pursuance of this plan, the cards have been counted and recounted on the machines for eight different forms of result slips, the aggregate number of cards being 7,391,122.[3]

This computation of costs is obviously based on labor cost alone, figuring time at about 40 (or 43) cents per hour. If there had been included machine rental at 65 cents[4] per 1,000 cards tabulated, this would have added $4,800 more—though it would leave the total cost still less than two-thirds of the hand-consolidation cost.

---

[1] Memorandum of H. H. Allen, May 24, 1909, p. 13.

[2] There is basis for the assumption that these were multicolumn sorters, in spite of the fact that multicolumn sorters did not come into general use until after 1940. Note especially this from a reminiscent letter written by Hollerith in 1919 to an official of IBM: "In the case of the population machines we had to sort according to combinations of two or more holes. One of these holes might be at the top of a card and the other at the bottom and besides they might be in different columns. . . . There is no doubt that these machines are the very best type that I have ever developed and the only reason I did not continue to use them was that they were rather complicated . . . and would have tied up a lot of capital in building them."

[3] *Report of the Director of the Census, 1903*, p. 10.

[4] See p. 119, below.

Digitized by Google

This method of obtaining large-area data was not generally adopted, however. Intermediate between these two methods might be mentioned the use of summary cards, in which were punched the primary totals, for consolidation on an adding tabulator. These summary cards were first used, for population, toward the close of the 1930 census work, specifically for transposing the results tabulated by industries under each occupation, into tables showing occupations under each industry. (Similar rearrangements of manufactures material, first by industry and then by States, were obtained in 1910, by cutting one-line strips of photostats of the original tabulation and rearranging the lines in the new combinations.)[5]

Such enthusiasm for the automatic machine was not quite universal, however, and there are suggestions in the records to the effect that it might be (or definitely, that it was) more economical to make the small runs on the hand-feed machine—partly, perhaps, because for the small runs so large a part of the operator's time was devoted to reading and resetting the counters, an operation common to both machines, and because the hand machine required only one operator.

In a memorandum dated May 24, 1909, relative to the planning of a supply of machines for the 1910 census, H. H. Allen specifically states that "it would be unwise, if not quite impossible, to tabulate a census solely by an automatic machine, owing to the fact that at least one-half of the work can best be done on the semiautomatic." This statement was made, in spite of the fact that the Philippine census, involving the tabulation of 7,635,000 cards, was all done on the Hollerith automatic machine, and of the optimistic report from the Division of Vital Statistics, referred to above.

The Census Machine Shop.—When S. N. D. North took office as Director of the Census on June 8, 1903, he found that contracts were already in force covering the rental of 8 Hollerith automatic tabulating machines and 2 sorting machines at rates which seemed to him excessive, being 65 cents per 1,000 cards tabulated for the tabulating machine and 18 cents per 1,000 cards sorted for the sorting machine. This contract was subject to renewal year by year. Efforts to get a substantial reduction in these rates were unsuccessful and North refused to renew the contract on its expiration at the end of the second year, on June 30, 1905.

The rates per 1,000 cards just quoted would indeed seem to be excessive, even for the old hand-feed tabulator. Assuming that with the old machine an operator would tabulate an average of even 8,000 cards per day, the rate of 65 cents per 1,000 cards would amount to $5.20 per day, or $1,560 per year of 300 working days. This figure may be compared

[5] *Report of the Director of the Census for 1910–11*, pp. 31–32.

Digitized by Google

with the rental of $1,000 per annum which was paid for similar machines used in the 1900 population census. But the automatic machine would handle four or five times as many cards per day, at least, so that the daily rental, at the same rate per 1,000 cards, would reach a figure truly exorbitant. Assuming no more than 32,000 cards per day as the average output, the annual rental would amount to $6,240, or far more than the cost of constructing the machine.

According to a memorandum of H. H. Allen, dated September 25, 1909, however, the rates were reduced to 50 cents per 1,000 cards tabulated and 13 cents per 1,000 cards sorted, for the year 1904–5. But even this rate for tabulating would indicate a potential annual rental of around $5,000. This contract was finally approved, in spite of the personal objection of Mr. Hollerith. "Under this contract," the memorandum continues, "the company was paid in nine months the sum of $18,114.70, and it incurred an expenditure for maintenance, etc., of possibly $2,000." [6] This figure, based on actual payments for actual time used, would indicate an annual payment per annum per tabulating machine of around $2,600, which still seems "excessive and exorbitant," as compared with the $1,000 per annum of 1900. And even making generous allowance for the probability that the machines may not have been in use for the entire time that they were under contract, and also for the fact that these so-called rental charges covered maintenance, changing of wiring when needed, etc., as well as the use of the machines, one must feel that North was well justified in objecting to the rates.

It may be noted that at some time shortly after the Hollerith machines were taken away from the Bureau, a contract was made with Charles F. Pidgin, of Boston, for the use of his tabulating system or "counting machines," and that the sum of $3,352.69 was paid to him under this contract. There is no record, however, of the specific apparatus used under this contract—though from other sources there is information with respect to a considerable assortment of tabulation devices used in the Massachusetts Bureau of Labor Statistics, and presumably used also in the tabulation of the Massachusetts State Census of 1885, under the supervision of Mr. Pidgin and William C. Hunt; and again in the Massachusetts census of 1895.

In anticipation of the attitude of the Hollerith Co., North had requested and had received from Congress an appropriation of $40,000 for the cost of experimental work in developing tabulation machinery[7] during the year 1905–6. Under the provisions of this appropriation, the Census Machine Shop was started in limited quarters furnished by the

[6] Both rates based on Allen's memorandum, which is printed in *Hearings before the Committee on the Census of the Senate*, 1st sess., 61st Cong. (1909), App., p. 78.

[7] 33 Stat. 683 (Holley MS, p. 36).

Digitized by Google

Bureau of Standards, under the general supervision of S. W. Stratton, chief of that bureau, but directly in charge of Charles W. Spicer, assisted by Eugene M. LeBoiteaux and O. Lewis Cleven, all three previously employed by Hollerith. H. H. Allen, a patent examiner, was shortly transferred to the Census Bureau, and presently placed in charge of all mechanical work—primarily, one may assume, to make sure that there was no infringement of valid patents. The original patents on Hollerith's hand-feed machines expired on January 8, 1906, it may be noted, so that these mechanisms could be used as a basis for further development. In the spring of 1907 the work was transferred to a newly equipped shop in the Census Building (on B Street, NW., between First and Second Streets). This shop occupied space about 25 feet by 100 feet and represented an investment of around $18,000.

The semiautomatic tabulating machine.—That the work had progressed beyond the merely experimental stage was evidenced by the successful utilization of the so-called semiautomatic tabulating machine in the Cuban census of 1907. This machine embodied two improvements on the machines used in the 1890 and 1900 censuses. First, it substituted an electrical button (or bar, like the space bar on a typewriter) for the old-fashioned hand lever. Its operation therefore required far less effort on the part of the operator. This feature alone, which was devised in 1906 or earlier, materially increased the speed of operation. The machine with this improvement alone has been sometimes referred to as the semiautomatic tabulator.[8]

Second, the machine was provided with printing counters, so constructed that they could all be set back to zero by one simple motion of the operator. This device eliminated the time-consuming process of reading counter by counter and recording the totals on a result slip, though the printed totals were contained on long strips of paper, not at all convenient for transcribing to table forms or consolidation sheets. This device still further increased the speed of the machine, though it was still necessary to feed the cards in one by one by hand.

The printing counters, 1906–7.—The printing counters represented a radical departure from the dial-face counters of the earlier tabulating machine, though they were perhaps similar in general method of internal operation to the counters on the adding tabulators used for 1900 agriculture. They had, of course, printing faces in place of the digits from which were read off the acres and bushels of the farm census, seemingly a rather simple adaptation of an established procedure. They were, however, as compared with later developments, clumsy and of such large size that the printed results required very large areas of paper for their recording. In general, the printing device comprised

[8] H. H. Allen, memorandum of September 25, 1909, pages 5 and 7; several machines of this type, supplied with dial counters, were built, just prior to the introduction of the printing device.

Digitized by Google

six rolls of paper tape, not more than 2 inches wide, with mechanism to feed the tapes horizontally across the back of the machine, under the rows of printing counters, with hammers to press the paper against the type for each reading.

The results appeared, therefore, in the form of long narrow strips of paper, six of these together containing the results of a tabulation equivalent to what could have been taken off a 60-counter dial board of the old type. Alongside each figure on the paper tape was printed a "designation," indicating the nature of the figure; for example, in an age tabulation a figure might be designated "Age 32." By reason of the extent to which the figures were thus spread out over long strips of paper, it was necessary to transcribe the data to consolidation sheets before making any use of them in the preparation of tables. But at any rate it was not necessary for the machine to stand idle while the operator copied 40 or 60 numbers off the dial board; and most of the result slips used with the dial board machines were designed primarily for the convenience of the tabulating machine operator and had to be transcribed to other sheets for consolidation. On the completion of the printing of the results of a given run, all the counters were set back to zero by the operation of a single lever.

Figure 41 represents the back of a tabulating machine with 27 counters in operative position. The paper reels are shown at the left, with the paper ribbons passing beneath the counters, above the printing hammers. These hammers are shown more clearly in the lower rows, where there are no counters in position.

These printing counters, it may be noted, were used interchangeably, either with the semiautomatic machines, for which they were first devised, or, later, with the automatic, self-feed machines.

Totalizing counters.—These machines were also equipped with totalizing counters—that is, special counters that could run on, without resetting, through the tabulation of several packs of cards (several areas) to provide readymade totals in many cases.

The census automatic tabulator, 1907–8.—An automatic (self-feed) tabulating machine, with capacity comparable with that of the Hollerith automatic machine but with printing counters in place of the traditional dials, had also been constructed and was in process of being tried out, in 1907, for the elimination of what would in current parlance be termed "bugs." The general principle on which this machine operated was fundamentally different from that of the Hollerith automatic tabulator (or from most other card-actuated machines, including card sorters). In most other machines, the response of the machine to the different positions of the holes is based on the position of the card at that point in its passage through the machine when the hole in any column comes opposite a single contact point in the path of the card. The census

Digitized by Google

automatic tabulator, however, contained for each column to be tabulated a complete set of 12 brushes or contact points; and the counting and relay devices were controlled by the position of the brush through which the electrical impulse came (just as they had been controlled by the position of the needles in the hand-operated press). Thus, the impulses from all fields came at the same instant, rather than one after another as the various (vertical) positions in the several fields came opposite the reading brushes.



FIGURE 41.—Printing counters for Census tabulating machine

Compact result slip for the tabulating machine.—By the end of 1912 one more very important improvement in the tabulating machine had been perfected and introduced into the machines still in use, both semiautomatic and automatic. This comprised a very important change in the printing mechanism. The printing wheels were first made much smaller and more compact; then they were arranged in six horizontal rows, about 5 inches apart, so as to print the figures recorded on 60 counters on a single sheet of paper 14 by 30 inches. The paper holder was so arranged that it could be raised ¼ inch after printing the first line, so as to print a second line under each of the six rows of counters, and then another line, making as many as 15 lines of similar data from each of the 6 rows of counters. These figures were in position

Digitized by Google

for addition without transcription, so that many of the necessary operations could be made right on the result slip. See illustration of a section of this result slip in figure 42. It is recorded that this change was devised and suggested to the Machine Shop by Director Durand,[9] who, while not an expert mechanician, did display a very thorough understanding of all the various factors entering into the conduct of the census.

In his final report as Director, dated December 31, 1912, Dr. Durand expressed the opinion that the saving of labor resulting from the change in the form of the printed result slip from the long strips used for most of the 1910 tabulations, which required complete transcription before even the simplest consolidations could be made, was more than that secured by substituting the printed strips for the dials or than that resulting from the automatic feeding of the cards in place of putting them into the tabulator one by one by hand.[10]

Further developments suggested.—In this same report Dr. Durand comments on the punching machine devised for the 1910 census (the Powers keyboard punch), suggesting that for future censuses a simpler punch might well be devised—this in view of seemingly persistent trouble with the 240-key machine. His comment on the possibility that the 11-key punch used for 1900 agriculture might sometime be used for population looks forward to the 1930 census, in which, through some substantial changes in the pattern of the card, a 12-key punch was used for punching the population cards.

There is also a long paragraph on the advantages to be gained through the development of an integrating (adding) tabulator for the Census Bureau. Such a machine was actually developed late in 1936 but was never extensively used, as it seemed better, after favorable experience with the 1920 census of agriculture, to depend on rented (IBM) machines for large volumes of aggregative work.

The Powers punch.—In 1907, James Powers, one of the machine shop experts, was detailed to work out an automatic card-punching machine. This machine, as developed and improved over the next 2 years, seemed to be satisfactory, and in August 1909, contracts were let for the construction of 300 of them (at a cost of $250 each). Contracts were made at the same time for 100 of the semiautomatic tabulating machines, as described above, at a cost of about $800 each.

The new punching machine is effectively described in a paragraph from Director Durand's report of December 1, 1909, as follows:

> The punching machine to be used at the present census differs materially from that used at the last census. The former punching machines had only one key, which had

[9] See his autobiography, *Memoirs of Edward Dana Durand*, privately printed, 1954, p. 162; and also "Tabulation by mechanical means—their advantages and disadvantages," by E. Dana Durand, p. 85, in *Transactions of the Fifteenth International Congress on Hygiene and Demography*, Vol. VI, *1912*.

[10] *Report of the Director of the Census* for the year ending June 30, 1912, p. 12.

Digitized by Google

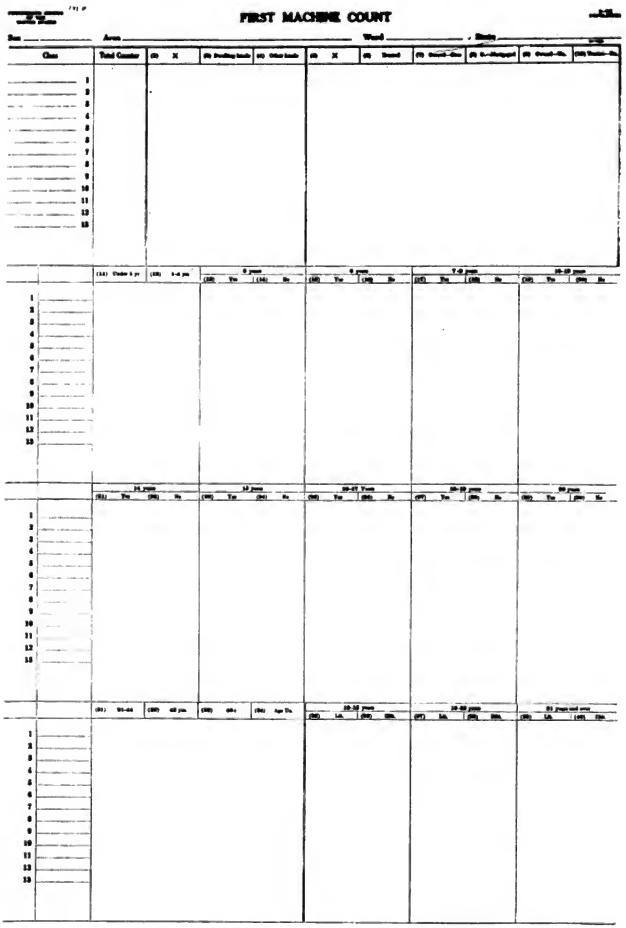


FIGURE 42.—Section of new result slip for tabulating machine. Complete sheet comprised six decks, of which only four are shown in the illustration.

Digitized by Google

to be moved about and pushed through the proper holes. The new machine has 240 keys corresponding to the various possible facts and operated somewhat in the manner of a typewriter or an adding machine. All the necessary keys for punching a given card are set before any of the holes are actually punched. An error in setting a single key can thus be readily corrected, whereas formerly if an error was made the card had to be destroyed, although many holes might have been already punched in it.

This change, together with the greater clearness of the designations of the various facts on the keyboard, will, it is believed, materially increase the accuracy of the punching and also increase the speed with which it is done.[11]

It may be added that this machine also provided keys for the geographic identification, heretofore provided by the gang punch, which required an additional handling of the cards; this saved many thousands of dollars and some chance of error. The cards were fed into the machine automatically, rather than having to be inserted one by one. The machine also had provision for a limited amount of counting, attached to selected keys, though there is no record that this device was actually used in the 1910 census. It did, however, sort the cards by sex, thus saving one run through the sorting machine. This machine is illustrated in figure 43.



FIGURE 43.—Powers punch

[11] *Report of the Director of the Census, 1908-9*, dated December 1, 1909, p. 19.

Digitized by Google

Sorting machines.—Reference is made in the same report to experimental work on sorting machines, though apparently the Census-developed sorting machine was not perfected in time for the 1910 census. Nor is there any mention here of the 20 sorting machines purchased in 1902 from the Tabulating Machine Co. for use with the 1900 crop cards, and later rebuilt, in the Census Machine Shop, to adapt them to the somewhat larger population card—though these machines were eventually used for sorting throughout the 1910 census.

No punched cards for the 1910 census of agriculture.—For the census of agriculture it was decided not to use punched cards, by reason of the unduly high cost of this work as it was done in 1900.[12]

Instead, the tabulations for 1910 were done for the most part on Burroughs adding machines with wide keyboards, which could be split into sections so as to add at one handling of the schedules as many as three items, like acreage, production, and value of crops. This work involved the sorting of the schedules by the major classification items, but this sorting had been done, perhaps needlessly, in 1900. (See comment above, pp. 104, 107.)

Hollerith offer of machines for 1910.—It should not be assumed that the Tabulating Machine Co. had given up hope of participating in the tabulation of the 1910 census. Under date of February 3, 1909, in a letter addressed to William S. Rossiter, Chief Clerk (principal administrative officer) of the Bureau, Mr. Hollerith, knowing, perhaps, that the Machine Shop had not yet produced an immediately usable automatic tabulator or an integrating tabulator, proposed, first, to furnish adding tabulators and sorters adequate for the 1910 agricultural census (no specific rental terms mentioned), or, if these were not to be needed, by reason of change of method for agriculture, to give the Census Bureau license rights for use of Hollerith-pattern automatic tabulating and sorting machines in tabulating population and vital statistics, these last for the lump sum of $100,000.[13] One may question whether the Bureau might not have saved money and gained time by accepting this offer, especially since, under such an arrangement, the printing counters already developed in the Bureau might have been combined with the automatic feed device covered by the Hollerith patents. In 1909, however, the current opinion seemed to give less importance to the automatic feed than one might be inclined to give it now, in retrospect.

---

[12] It was recorded that the 1900 tabulation of the farm census, "apart from revision of agricultural schedules," had cost $158,255, or an average of 22 cents per schedule. For comparison, a hand tabulation of the 4,316 schedules for Champaign County, Ill., was made parallel with the 1900 tabulation. This showed a cost of only 10 cents per schedule, or less than half the average cost of the 1900 farm census, using Hollerith machines.

[13] Letter quoted in *Hearings before the Committee of the Census of the Senate*, 1st sess., 61st Cong., on the bill (H.R. 1033) to provide for the thirteenth and subsequent decennial census, App., p. 66.

Digitized by Google

THE THIRTEENTH CENSUS, 1910

The census of 1910 was taken as of April 15, 1910; and by the end of June the clerical force in the Washington office had been increased to more than 3,000—with a further increase to 3,800 as a maximum, in September.

The population schedule was similar to that used in 1900, with 50 lines on each side of a large sheet, or 100 lines in all (one line for each person enumerated), and a column for each census question. The first step in the tabulation of the population schedules was the so-called hand count, a count of the population which was used, first, as a basis for paying the enumerators, and then, after verification, for the announcement of the population of the various States, counties, and cities.

Second was the editing of the schedules, in preparation for punching. This process was especially important in connection with the returns for mother tongue of the foreign stock.

The third process was the punching of the cards, one for each individual returned on the schedules. It was proposed to do this entirely on the 300 new keyboard machines referred to above; but there was some delay in the delivery of these machines, and considerable difficulty was experienced in the operation of the first machines received. For these reasons it was decided to use some of the old pantograph punches used in the 1900 census and owned by the Census Bureau. The defects in the keyboard punch machines were gradually remedied by the Machine Shop, so that about two-thirds of the cards were punched on them—specifically, 63,500,000 on the new machines and 30 million on the old pantograph punches. The new machines were more rapid, producing an average of about 1,800 cards per day, as compared with 1,200 from the pantograph. It may be noted, however, that the keyboard machines were not used for any later census—though the general pattern of the machine was the same as that of the so-called Powers punch, used later for commercial work by the Powers Tabulating Machine Co., the principal competitor, for many years, of the Hollerith Co. in the commercial field.

Fourth, the punching was verified by comparing a certain proportion of the punched cards with the schedules.

Fifth was the verification run, a special run of the cards through a tabulating machine designed to identify and reject cards that were imperfectly punched and also cards in which were punched inconsistent entries, such as a 7-year-old child returned as married. (See detail below, p. 147.)

Sixth was the sorting of the cards, by means of electric sorting machines, into fundamental groups, as by color or nativity. This was done largely on the sorting machines purchased in 1902 from the

Digitized by Google

Tabulating Machine Co. and widened in the Machine Shop for use with the larger population cards. The machines had also been materially improved, especially by changes which increased the speed of operation.[14] These machines, with further improvements, were used in the 1920 census, along with additional sorters devised and built completely by the Machine Shop.

Seventh was the tabulation of the data required for the reports that were to be published. The major part of this work was done on the semiautomatic machines described above, though as various improvements were incorporated in the automatic (self-feed) machines, they were used more and more in the later runs.

Detail of the 1910 population schedule.—The 1910 population schedule, as already indicated, was printed on a large sheet containing 32 numbered columns and 100 lines (50 on each side) on which were recorded the census items for 100 persons. The numbered columns, omitting those used for identification alone, were as follows:

4. Relationship to head of family
5. Sex
6. Color or race
7. Age at last birthday
8. Whether single, married, widowed, or divorced
9. Number of years of present marriage[15]
   Mother of how many children—
   10. Number born
   11. Number now living
12. Place of birth and mother tongue of person
13. Place of birth and mother tongue of father
14. Place of birth and mother tongue of mother
15. Year of immigration to the United States (for foreign born only)
16. Whether naturalized or alien (for foreign born only)
17. Whether able to speak English, or if not, language spoken
18. Occupation
19. Industry
20. Whether employer, employee, or working on own account
21. Whether out of work on April 15, 1910 (for employees only)
22. Number of weeks out of work during 1909 (for employees only)
23. Whether able to read
24. Whether able to write
25. Attended school any time since September 1, 1909
26. Home owned or rented[15] (for family heads only)
27. If owned, free or mortgaged[15] (for family heads only)
28. Farm or house[15] (for family heads only)
29. Number of farm schedule (for verification of return of "farm")
30. Whether a survivor of Union or Confederate Army or Navy

[14] The "famous" suit brought by the Tabulating Machine Co. in 1910 against Dr. Durand, as Director of the Census, was based on the claim that in remodeling these machines the Census Bureau had in effect built new machines which infringed on some of the Hollerith patents. This suit was finally disposed of without significant action.

[15] Items not punched in the population card. These questions were reserved for a proposed family card, which was never completed. Data on dwellings and families and tenure of homes were obtained through a relatively simple hand tally.

Digitized by Google

Columns 12, 13, and 14, as printed on the schedule, called for place of birth alone, but an Act of Congress, passed after the schedules had been printed, required an inquiry on mother tongue. So the enumerators were instructed to write both place of birth and mother tongue in the space designed for place of birth alone. Because of the insufficient space into which it was thus crowded, the mother-tongue item was difficult to handle throughout the coding and punching operation and was without doubt more completely coded than might otherwise have been necessary.

Except for this block of questions, the inquiries carried on the schedule differed on only a few points from those of 1900. The question on ability to speak English was amplified on the schedule by asking for language spoken, if not English; but these entries were not coded or punched in the card. The classification of gainful workers was made more specific, through the use of two questions, one on occupation, "trade or profession, or particular kind of work done," and one on industry; specifically, "the general nature of the industry, business, or establishment in which this occupation was carried on." This resulted, eventually, in a new type of table, showing the various occupations pursued in each of a selected list of industries.[16]

The 1910 population card.—The 1910 population card differed in two general aspects from that of 1900: First, it was arranged for the most part in columns or groups of columns, to be punched one after another across the card, rather than in two series of half-column fields, to be punched across the top of the card and then back, from right to left, across the bottom—though there was a brief cutback for two small fields at the very end. The main purpose of this change was to adapt the card to the sorting machine, which operated column by column.

Second, the printed symbols, indicating what was to be punched in each punch position, were set up above and to the left of the exact punch position, so that the symbol could be read after the hole had been punched (rather than being punched out, as in 1900), thus doing away with either the reading board of 1890 or the need for memorizing the content of the card, as in 1900.

When the card was designed, it was expected that it would be punched on the Powers full-keyboard punch, though it proved to be conveniently handled, also, by the old pantograph punch, which was used for about one-third of the 1910 cards. Both 1900 and 1910 cards had 24 columns, each comprising 12 quarter-inch square punch positions.

The 4-column geographic identification space was divided into 8 irregular fields, rather than into the 6 regular fields of the earlier censuses, to meet the requirements of a new geographic code.

---

[16] See *Thirteenth Census of the United States, 1910*, Vol. IV, Population, Occupation Statistics, table VI, pp. 302 ff.

Digitized by Google

The card, as punched, is illustrated in figure 44, which shows the symbol for each punch position, as offset from the exact spot to be punched out in each case, so there is no need for an illustration of an unpunched card. This figure may be compared with the 1900 card, as shown in figure 31, or with the 1890 card pattern, as shown in figure 16.

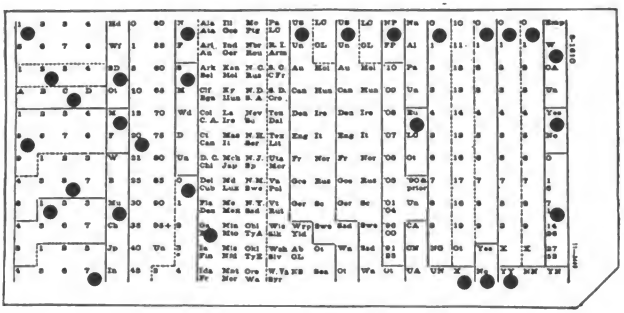


FIGURE 44.—1910 card for population

Comparison with 1900 card.—The changes in the content of the several fields may be summarized as follows:

Relationship to head of family, 4 positions, was restored from the 1890 card, though it was not tabulated, either in 1890 or in 1910.

Sex, no change. (Note that the cards were sorted by sex in the process of punching.)

Color, same as in 1900, except B and Mu in place of B alone.

Age, same as in 1900, except 15–19 age period not split (15–17 and 18–19) as in 1900; unit ages designated simply 1, 2, 3, etc., in place of double values, 1/5, 2/6, etc. This apparently helpful detail was presumably deemed not worth while.

Conjugal condition, same as in 1900, except no separation of those married less than 1 year; that is, M only, in place of M0 and M1 (which, after being punched in 1900, were never tabulated separately).

Nativity, N and F, cut in over conjugal condition, just preceding the detail on birthplace and mother tongue, as in 1900.

State or country of birth of person set up (almost) in four solid columns rather than in parts of eight columns. Double position designations as in 1900, State in upper position, for native persons, and country in lower position, for foreign born, except that the fourth column carried mother tongue of person in lower position, making *two* punches in this general field for a foreign-born person.

758-612 O - 65 - 10

Digitized by Google

Place of birth of father and mother, same as in 1900, except each in (nearly) two full columns instead of in a block. Two positions indicating mother tongue of father and mother were set into each of these place-of-birth sections, indicating language of country (LC) and other language (OL), a vigorous contraction of the mother tongue provisions for persons. The cards punched OL were to be rejected, however, and the language returned written on the card for hand sorting. This is one more indication of the fact that, up to this time, the tabulation was far from completely mechanized, and that much was still left to be handled somewhat as in 1880 and earlier by individual allocation of returns, simplified only by the fact that the material on cards was much easier to handle than that on the original schedules.

Parentage, a new classification so far as the punch card was concerned, followed place of birth of father and mother, to separate the native population into two classes, native parentage (both parents native) and foreign (foreign or mixed) parentage. Before punching this field, the puncher had to inspect the returns for birthplace of both father and mother—another case where he had to *think*, rather than just to punch what he saw on the schedule. Note that this classification was obtained in 1900 and 1890 through rather complicated relay circuits on the tabulating machine.

Citizenship, same as in 1900.

Ability to speak English—three positions, cut in under the positions for citizenship: En, English; LC, language of country; and Ot, other language. But note that only two positions, the first and last as mentioned, were actually punched in the cards, giving, in effect, as in later censuses, English, Yes or No.

For occupation and industry there were five almost solid columns in 1910, in place of the irregular blocks of the 1900 card. Note that the numbers in the first two columns ran consecutively from 1 to 20, so that 5-figure occupation code required only four positions.

Employment status, a new classification not carried on the schedule in 1900. This provided four positions, at the top of the last column on the card, for Employer (E), Employee or "Wage Worker" (W), Own-account worker (OA), and Unknown or not reported (Un).

Unemployed on census date, Yes or No, with a separate field for punching the number of weeks unemployed in 1909 occupying seven positions in the last card column.

Literacy, able to read and to write (separate questions on the schedule), Yes–Yes (YY); No–No (NN); and Yes–No (YN) able to read but not to write, eventually counted as illiterate. These items occupied a separate field cut back at the bottom of the last three columns on the

Digitized by Google

card, rather than being combined with school attendance, as in 1900. But persons attending school were required to be punched YY, even if there was no reply or a negative reply under literacy.

School attendance, attended school in past year, Yes or No, in a separate field.

Veteran status—five positions, cut back under the occupation field, for an 1890 question resurrected for 1910—not carried on the schedule in 1900.

Punching the cards.—The method of identification between card and schedule was substantially the same in 1910 as in 1900. (See p. 91, above.) And in fact, the instructions for punching the 1910 population cards were not materially different from those of 1900 (given in some detail above), except for the complicated cases arising out of the addition of the question on mother tongue; and for a few situations in which certain fields were left unpunched specifically to insure the rejection of cards which it was desired to check further against the schedule. These included:

An entry in schedule column 6 of a race designation other than the six printed on the card; for example, Philippino; these cards were rejected, for lack of any punch in the field, checked back to the schedule, and the "minor" race written on the card for later hand tabulation.

Age reported as 95 or over; these cards were automatically rejected, as having nothing punched in the age field, and were checked back to schedule for verification—as was done with the rejects from the 1900 verification run.

Naturalization was punched only for foreign-born males 21 years old and over. The omission of punches in this field for persons other than the 21-plus foreign-born males would not affect any tabulation nor serve any checking purpose, since the tabulation of citizenship was made only for the foreign-born males 21 years old and over, sorted out from among the other nativity-sex-age classes. It would, however, save several hundred thousand punch strokes.

Class of worker was not punched for persons punched Ot or NG in the occupation field; this field was never tabulated, though it may have been used in connection with the tabulation of unemployment.

Unemployment was not punched in any cards except those with W punched in the class-of-worker field. This, again, was mainly for saving punching effort, since the tabulation of unemployment was limited to wage worker cards.

Military service was not punched except where the return was complete; lacking a complete return, the field was left blank.

Digitized by Google

The instructions for punching mother tongue were, as already indicated, decidedly complicated, even after a very large percentage of the returns for the foreign born had been specifically coded for mother tongue.

For 18 specified countries of birth it was assumed that the mother tongue was the usual language of the country, and the cards were punched LC, language of country. These 18 countries comprised Bulgaria, Denmark, Italy, Spain, and 14 others, including some in which the basic assumption seems hardly so obviously justified. For countries other than these 18, the mother tongue was "indicated . . . by punching keys which do not in themselves bear the name of a particular language, but which indicate different languages for different countries. These keys were LC, meaning language of the country, which was used for the principal language of the country; OL meaning other language, which was used for the next most important language; and CFr, which was used for the third important language of the country." [17] (The key CFr was originally intended for Canadian French, but was actually used as just indicated.) Somewhat briefer forms were used in the red-ink symbols entered on the schedules; L for LC; O for OL; and C for CFr.

Where the schedule gave the country of birth but not the mother tongue, it was directed that the card be punched Un in the mother tongue column. There was no printed symbol for Un in this field, but there were two unused (undesignated) positions at the bottom of the field, one of which was doubtless used for this purpose.

For the occupation fields, the punchers were given a list of the codes for the more frequent occupations, with instructions to punch the remaining (more difficult) occupations Ot. The Ot cards were later sorted out, sorted back to schedule order, and punched with complete code numbers as determined by a special editing process. This procedure was adopted in order to expedite the tabulation of the more urgent nonoccupational items; but in actual experience the procedure proved so expensive and time-consuming that it was not repeated in any later census.

Sorting and tabulation.—Since the general patterns of tabulation in 1910 and 1920 were very similar, the presentation of this material will be deferred until after the discussion of the changes in cards, machine equipment, etc., between these two dates.

[17] Quoted from the instructions for punching. The "keys" referred to are the keys on the Powers keyboard punch, described above, and illustrated in figure 43.

Digitized by Google

FAMILY CARD PROPOSED FOR 1910

In the general planning for the tabulation of the population data for 1910, it was proposed to make use of a family card somewhat like that punched and partly tabulated for 1900. The card proposed for 1910, however (see figure 45), was only to a limited extent a family card, but was rather a card designed primarily for an elaborate tabulation of the data relating to the returns on fertility (children ever born).

The card was set up in two sections. The first (left-hand) section was to be punched for every head of family, male or female, and for nonhead husbands of women represented in the second section, if reported on the schedule.

The second (right-hand) section provided space for punching, for every married, widowed, or divorced woman, the number of children reported, together with various items of personal information.

The items to be punched for the persons represented in the two sections of the proposed card, running somewhat parallel, were as follows:

For both sections of the card:
- Relationship to head
- Color or race
- Marital status, including distinction between first and later marriages (M1 and M2)
- Age, in 5-year periods, beginning with under 15 (with single years for women, in section 2)
- Parentage for natives and country of origin for foreign stock, in a rather complex condensed arrangement

For the left-hand section only:
- Sex
- Occupation-industry
- Tenure (for heads only)

For the right-hand section only:
- Literacy
- Gainful worker or not (Oc or NG)
- Gainful ever born, up to 17-plus
- Children living, up to 10-plus

It may perhaps be assumed that this card was currently regarded as a fertility card rather than as a family card. Note this paragraph from the 1909 report of the Director: "It is also proposed . . . to work out from the returns on the schedules, statistics with regard to fecundity as indicated by the number of children born and the number living, for women of different classes, in comparison with their age and the duration of marriage. A separate set of cards . . . is required for this tabulation."[18]

[18] *Report of the Director of the Census for 1909–10*, dated December 31, 1910, p. 45.

Digitized by Google

The distinction between M1 and M2 must have been placed on the tentative card by mistake, since there was no entry on the schedule by which to distinguish between first and later marriages. And there should have been a field for duration of marriage, from column 9 on the schedule. This classification is specifically mentioned in the Director's summary of the proposal, just referred to; and it is obviously required for any adequate tabulation of the data on fertility.

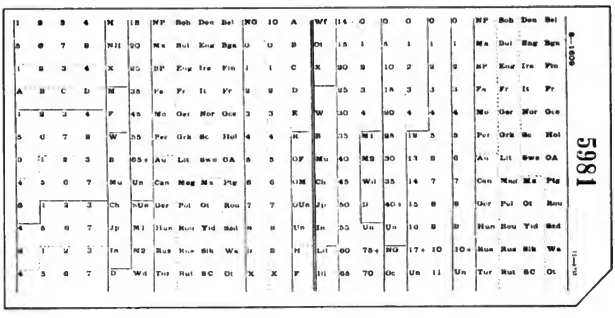


FIGURE 45.—Family card proposed for 1910

The first problem in punching this so-called family card was the selection of the individuals for whom data were to be punched so as to include (a) all heads of families (for the tenure tabulations), (b) all married, widowed or divorced women (or, to use a rather unsatisfactory current designation, all "ever-married" women),[19] and (c) the *husbands*, so far as returned on the schedules, of all women shown in the second part of the card.

Of strictly family classifications, these cards would provide only for tenure of home and for a series of classifications by characteristics of head. There was no material even for the basic classification of families by size. On the other hand, looking toward material that would be significant in connection with number of children born to the women represented in the right-hand section of the card, there was material for dozens of significant cross-classifications—especially classifications of husband-and-wife families by combinations of characteristics, age of husband by age of wife, etc. More's the pity, then, that this proposed card was crowded out of the 1910 program.

[19] Compare "ever-married" with almost any other of the rather numerous expressions compounded with "ever": for example, ever-present ever-normal (granary), everlasting, evergreen, ever-young.

Digitized by Google

SPECIAL HAND TABULATION, 1910

By reason of the failure of the proposed family card program, two essential features of the census tabulations were left unprovided for, namely the counts of dwellings and families, and the classification by tenure of home. These were doubtless the items referred to as "a few minor facts" in the following quotation from a current report of the Director: "These four runs developed all of the facts relating to the population except only those relating to occupations (obtained in later runs of the cards) and a few minor facts which were obtained by tallying direct from the enumerators' schedules and not by the use of cards." [20]

For the count of dwellings and families, as such, even the proposed card made no provision; but included as a part of the "editing" of the schedules in preparation for the punching of this card, was a requirement that both dwellings and families be clearly identified by red-ink check marks. These were doubtless counted in the special hand tally; and it may even have been a part of the initial plan to get the information in this way, in addition to the family card, rather than through any tabulation of cards. And with the same handling of the schedules it would have been simple to tally, from columns 26, 27, and 28 of the schedule, the items of tenure, including farm and nonfarm (or "farm" and "home," in the terminology of 1890–1900).

[20] *Report of the Director of the Census for 1910–11*, dated December 31, 1911, p. 22.

Digitized by Google

EXPERIMENT WITH FIELD-PUNCHED CARDS

In the special census of Okmulgee County, Okla., taken in August, 1918, the enumerator was required to punch a card (in the field) for each person enumerated. On this rather large card, which measured about 11¼ by 6½ inches, were provided punch positions for approximately the standard population data, arranged around three sides of the card, for convenience in punching with a modified (enlarged) conductor's punch. This card, much reduced in size, is illustrated in figure 46.



FIGURE 46.—Field-punched card for Okmulgee County, Oklahoma

There is no official report on the results of this experiment, nor any further recorded detail with respect to the method of tabulation. Oral tradition has it, however, that a machine was devised to translate these field-punched cards into regular 24-column tabulation cards, which machine did not come up to expectations. At any rate, since there was no further use of field-punched schedules, it may be inferred that the results were not encouraging.[21]

[21] There is extant a copy of a similar card designed for the 1917 census of the Virgin Islands; but this field-punched card was definitely not used in that census.

Digitized by Google

Chapter VII. THE FOURTEENTH CENSUS, 1920

Equipment available.—The Census Bureau had been actively at work on preparations for the 1920 census at least as early as 1917, though, as far as the task of tabulation was concerned, the emphasis had been placed heavily on the automatic tabulating machine, the unit counter as it was commonly termed in later years. Substantial improvements in the automatic tabulator used in the latter part of the 1910 census period had been completed and the new machine, illustrated in figure 47, had been thoroughly tested, in the tabulation of vital statistics material, by 1917. An ample supply of these machines had been completed and were on hand early in 1920, as follows:

35 automatic tabulator bases
40 automatic tabulator heads
156 counter units, each with capacity to record (print) 10 four-digit numbers

In effect, this provided 35 complete tabulators, with extra reading heads for emergency use, though with a none-too-adequate supply of counters. For some runs the machine required only three or four counter units, but for the full capacity of 60 items to be counted, six of these units were required.

In addition, there were 25 sorting machines, including some of the original Hollerith sorting machines taken over from the 1900 farm census equipment and rebuilt, first for 1910, and then, with further improvements, especially some late improvements which added materially to the speed of operation, for 1920. These sorting machines, however, were designed to sort only one column at a time, and thus required several handlings of the cards for a complicated sort, like color, nativity, and age. Note, however, that a practicable multicolumn sorter was not developed in the Bureau until around 1947. And note, also, that the old Hollerith sorting box actually did, up to its rather slow capacity for speed, unlimited multicolumn sorting (that is, combining two, three, or more punch positions).

The problem of a card punch.—In the matter of mechanical equipment for punching the cards, however, the outlook, as the census date approached, was much less favorable than with respect to tabulating machines. The Powers electric punch, designed for the 1910 census, had been used for about two-thirds of the 1910 cards, but was considered unsatisfactory, in spite of about 50 percent higher production, by reason of very frequent interruption of the work on account of mechanical difficulties.

Digitized by Google



FIGURE 47.—Improved unit counter, automatic

Even with extensive effort to improve its operation, this machine failed to come up to expectations. In April of 1919, a test of various available punching machines was begun, using the following machines:

a. Powers electric punch, with recent improvements

b. Old style pantograph punch, like those used for about one-third of the cards in 1910

c. Improved pantograph punch, equipped with automatic card feed and a punch control which prevented double punching or skipping a field

d. Commercial punch, similar to those used for 1900 agriculture and, on a rental basis, for 1920 agriculture. This punch, it should be noted, required that *all* data be reduced to numerical form—that is, either preceded or reduced to numerical form by the puncher. Note that, for simple classifications, this last was not a difficult task: for example, to punch "1" for male or "2" for female.

Digitized by Google

For the purpose of the test, 50 population schedules, as returned in the 1910 census, were selected and copied onto the tentative 1920 census schedule forms. These covered approximately 5,000 persons. Three copies were made, one for each of the three types of punches being tested; and there were various combinations of experienced and inexperienced operators.

A committee was appointed on June 25, 1919, to evaluate the results of this test. This committee expressed their judgment that the Powers punch, by reason of mechanical imperfections, was unsuited to the requirements of the 1920 census of population. Also that the commercial punch, submitted by the Tabulating Machine Co., while superior to any of the other machines tested in average output per operator, should not be adopted for the population census, since cards punched on a strictly numerical basis were not conveniently adaptable to the Bureau's tabulating equipment.

This phase of the problem was considered in great detail, with specimen wirings for the tabulating machine as required for cards punched on the Powers or pantograph punch and for cards punched on the commercial punch. The main arguments against the simple 12-key commercial punch were based on the fact that, for any classification involving more than 12 items, it required two punch positions, while with the pantograph or Powers punch, as many as 50 items in a classification could be represented by a single punch position—as, for example, place of birth. And the tabulating machine wiring for these two punch positions was more complicated and called for more relays. But more about this problem later, in connection with the 1930 census, for which the commercial type punch was finally adopted, in spite of the additional objection that it required more coding of the schedules before punching.

Further, it was made clear that one could not look forward to using the commercial punch for a part of the work (as with the Powers punch in 1910) and then filling in with the stock of pantograph punches if need be, since the two punches would require different card forms.

Thus eliminating the principal competitors, the committee recommended that the improved pantograph punch be adopted for punching the 1920 population cards.

The Bureau acquired all together 820 of these pantograph punches. The work of punching the approximately 106 million cards was completed about the end of September, 1920.

Tabulating equipment for 1920 agriculture.—For 1920, it was decided to use punched cards for the census of agriculture, as well as for population, in spite of the somewhat unsatisfactory experience of 1900, when it appeared that the tabulation had cost far more than it would have cost under alternative methods. Presumably, this was done on representation that the equipment currently available was sufficiently improved to

Digitized by Google

justify expectation of more economical operation. Or perhaps the officials in charge in 1919 or 1920 had forgotten the experience of 1900. A paragraph in the 1921 Director's report, referring to the use of punched cards for 1920 agriculture, begins with the words "For the first time in the history of the census, the agricultural data have been completely tabulated by the use of punch cards and electrical tabulating machinery."[1]

The Census Machine Shop (now the Mechanical Laboratory) had not at that time made sufficient progress on its long-delayed integrating tabulator[2] to offer it for the farm census, which was primarily an integrating (adding) project; hence, the equipment was mainly rented from the Tabulating Machine Co. (strictly, the Computing-Tabulating-Recording Co.—CTR—which, in 1924, became the International Business Machine Corp.—IBM).

The machinery employed in the tabulation of the 1920 census of agriculture comprised the following:

488 commercial punches (purchased)	58 integrating tabulators
47 verifiers	5 card counters
16 gang punches	69 sorters

The tabulator was equipped with automatic feed for the cards and showed the results of the tabulation on conveniently located counters, expressed in figures but requiring to be read and recorded on result slips, rather than being printed automatically on the sheets. The sorters were presumably similar to those used in the population work, except designed to handle the 45-column farm cards, or the smaller, but similarly spaced, crop and livestock cards. The farm card was similar, in general, to the farm card used in 1900 except that it had 45 columns instead of 36, but in place of the one crop card, used for many different items, there were 16 different cards designed to handle more efficiently the various crops and other products to be represented.

There was, however, no machine for making, efficiently, the unit counts of farms in the various cross-classifications or of farms reporting certain products. These counts were secured by sorting the cards into the complete detail and counting them on the card counter—a task for which, in 1930, census unit counters were "borrowed" from the population equipment.

Since this report is primarily related to the original Hollerith tabulating equipment and its further development in the Bureau of the Census, there will be no presentation of the details of the tabulation of the 1920 farm census.

[1] *Annual Report of the Director of the Census*, 1921, p. 12.

[2] In fact, the Census Bureau never did develop its integrating tabulator to a point where it seemed worth while to produce the machine in large numbers, in competition with the possibility of renting integrating machines for the larger jobs—perhaps in part because many of the "large" jobs were of short duration.

Digitized by Google

The 1920 population schedule.—The 1920 population schedule was similar in general form to that of 1910, though there were some changes in questions and in the order of arrangement of the questions. The several processes through which the data passed after the receipt of the schedules were likewise similar to the procedures followed in 1910.

The questions represented by the several columns on the schedule were as follows:

2. Farm or nonfarm residence
6. Relationship to head of family
7. Home owned or rented (for family head only)
8. If owned, free or mortgaged (for family head only)
9. Sex
10. Color or race
11. Age at last birthday
12. Single, married, widowed, or divorced
13. Year of immigration to the United States (for foreign born only)
14. Naturalized or alien (for foreign born only)
15. If naturalized, year of naturalization (this item was not punched in the card)
16. Attended school any time since September 1, 1919
17. Whether able to read
18. Whether able to write
19. Place of birth of person
20. Mother tongue of person
21. Place of birth of father
22. Mother tongue of father
23. Place of birth of mother
24. Mother tongue of mother
25. Whether able to speak English
26. Occupation
27. Industry
28. Employer, salary or wage worker, or working on own account

The 1920 population card.—The 1920 population card was similar in many respects to the 1910 card, following completely the pattern of arrangement of fields in columns rather than in blocks, and with the designations again offset so as to remain visible after the position was punched, etc. Much more space was devoted to place of birth and mother tongue, using columns saved by omitting occupations, which were punched on a separate occupation card. The main population card is illustrated in figure 48.

The principal specific differences between the 1920 population card and that used in 1910 are indicated in the following summary, field by field:

Three new fields were added, in the first column after the geographic identification section:

a. Farm residence (Fm and Ot), a new classification used for the first time in 1920 for the tabulation of population statistics, though in the

Digitized by Google

three preceding censuses it had formed a part of the tenure classification for families.

b. Head in relation to dwelling and family—DH1 for first head of family in a dwelling, DH2+ for second and later heads in the same dwelling, and X for a nonhead person. These symbols were used for a count of dwellings and families, independent of the count by tenure.

c. Tenure (for heads of families only): the usual symbols, R for renter, OF for home owned free, OM for owned, mortgaged, etc., with X for nonhead persons. The distinction between a farm and a "home" was obtained (in the tabulation) from the farm-nonfarm symbols noted above.

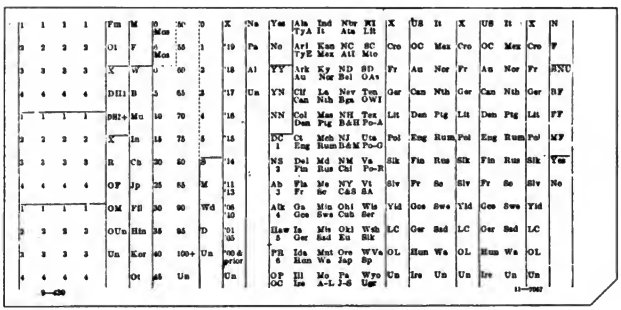


FIGURE 48.—1920 population card

The fields for sex and color or race, in the next column, were the same as in 1910, with the addition of symbols for additional "minor" races.

The field for age was the same as in 1910 except for the addition of more detail (0 mos and 6 mos) at the beginning of the series of age groups in the first column and for the omission of the special groups 20 and 21–24. This last simplified the punching considerably, at the expense of additional relays in the tabulating machine wiring.

Marital (conjugal) condition was the same as in 1910; year of immigration was the same except for later dates, and citizenship was the same, though now assigned a full column on the card.

School attendance and illiteracy were brought up from the end of the 1910 card to follow citizenship, but without change in content.

The field for place of birth was similar to that of 1910, occupying 4½ columns, with the now familiar alternative State-or-country symbols.

Mother tongue of person was assigned a single column, seemingly independent of country of birth, though a large percentage of the mother

Digitized by Google

tongue returns were represented by combinations between the punched symbol LC in this column and the country of birth, as in 1910.

For place of birth of father there were two full columns, providing space for a list of countries slightly longer than in 1910, but still condensed, and a full column for mother tongue, with symbols exactly like those for the person. And for country of birth and mother tongue of the person's mother, there was the same provision.

At the top of the last (24th) column on the card *following* the fields for place of birth, symbols for Native (N) and foreign born (F), transplanted from a position preceding the place-of-birth field on the 1910 card; and in a second field, in the same column, symbols for the parentage classes for natives: both parents native, including unknown (BNU), both parents foreign (BF), father foreign (FF), and mother foreign (MF). This represented an expansion from two symbols only (NP and FP) in 1910. Note that both of these fields require some "thinking" on the part of the puncher, rather than merely the transcription of symbols indicated on the schedule. It does seem better, though, to have these symbols, which depend on a classification of place-of-birth entries, appear after the place of birth has been disposed of, rather than before—or partly before and partly afterwards, as in 1910.

And finally, still in this 24th column, symbols Yes and No, for ability to speak English. This item was next to the last on the 1910 card, followed by a field for veteran status, a question which was omitted from the 1920 schedule.

The occupation card.—The special card for occupations, to which reference has been made above, was exactly like the "regular" population card through the first 17 columns, that is, through the column representing mother tongue of person (see figure 42). Next, in column 18, it carried the nativity-parentage symbols, from the last column of the population card, then three columns of digits for occupation code numbers, and finally a column with symbols for class of worker. This last column was not used, however, in any of the tabulations of this card. These occupation cards were individually punched from the schedule throughout, as there was no machine then available analogous to the present-day duplicating punch.

The occupation code scheme was considerably simpler than that used in 1910, which had separate symbols for occupation and industry. In 1920 each occupation was assigned to that industry in which it was most frequently carried on, with a special class for clerical workers, who were distributed widely throughout most of the industries. There was, therefore, no possibility of a two-way tabulation, occupation by industry, like that of 1910.

The classification of occupations is by far the most elaborate of all the census classifications. For use in 1920 there were provided classified

Digitized by Google

and alphabetical indexes aggregating around 400 pages and classifying more than 25,000 occupational designations. The work of classifying the 1920 returns, in preparation for punching the cards, occupied a force of 115 clerks for a period of 10 months, from July, 1920 to April, 1921. The work of punching the occupation cards was begun in September, 1920, and practically completed in May, 1921.

Punching the 1920 population card.—Blank cards serially numbered in blocks of 10,000 were furnished to the punching clerks, as in 1900 and 1910, with instructions to write at the beginning of each schedule sheet the number of the first card punched. This was to make it possible to identify any card with the schedule and line containing the data punched in the card. The puncher was supplied with the exact number of cards required for the enumeration district assigned to him, as shown by the hand count. This doubtless conduced to care in punching, since considerable effort was required to punch a replacement for a spoiled card and supply its serial number.

The cards were punched, as indicated above, on the pantograph punch, which was exactly like the punch used in 1890, 1900, and for a part of the cards in 1910, except that a device for preventing the omission of fields or double punching had been added.

The three new fields in the first column on the card were regarded as covering family data, perhaps because they comprised items which had appeared on the 1900 family card, though the first of these fields provided the basis for one of the outstanding innovations of the 1920 census, the tabulation of data for farm population as distinct from nonfarm population. Since the returns for farm residence were not always clear, this item was very carefully edited, so as to leave no doubtful cases for the puncher to struggle with.

The returns for the second field, requiring the selection of the first family head in a dwelling, were also carefully considered by the schedule editors, and the proper order of families within the dwelling clearly indicated in red ink, where there was uncertainty.

The punching for sex and color or race was simple and routine, and likewise that for age (once the duplex system of age groups and unit values was understood), and marital status likewise.

The introduction of the fields for citizenship and year of immigration, in advance of the punching of birthplace, may have caused some difficulty, except for careful editing, which included the solution of occasional problems with respect to the citizenship of married women. Note that women as well as men were included for the first time in the 1920 statistics on citizenship or naturalization.

By far the most difficult section of the card for the punchers, in 1920, as in 1910, even with adequate space for the entries, was that relating to

Digitized by Google

mother tongue. Again, there was provided a list of mother tongues to be punched as reported, without regard to country of birth, and another list of mother tongue returns that were to be punched LC (language of country) in combination with specified countries of birth, but this list was much simpler than the corresponding list required in 1910; and there were still other combinations of returns that were uniformly edited, so that the puncher had a specific red-ink symbol to punch. The whole problem of mother tongues was greatly simplified by the adopting of exactly uniform card fields for person, father, and mother.

The field for nativity, native (N) and foreign born (F), was the same as in 1900 and 1910, except that in 1920 it came at the end, after the place of birth had been punched and was (perhaps) still in mind. The parentage symbols had been expanded from 1910, splitting the earlier symbol for foreign-or-mixed parentage into three: Both parents foreign or of unknown nativity (BNU), father foreign and mother native (FF), and mother foreign and father native (MF). The punching of these symbols required that the puncher inspect (or remember) two or three place-of-birth entries, rather than, as in an ideal situation, punching exactly what he saw written on the schedule.

Finally, the last item on the punch card, ability to speak English, offered this ideal situation; the returns on the schedule were either Yes or No, and the card called for the punching of just that, Yes or No.

Details of Machine Tabulation, 1910 and 1920

The tabulation program for the 1920 census of population followed closely the pattern for 1910, with occasional amplification. Since there are available complete specifications for 1920, but not for 1910, it has seemed best to present here the 1920 program with occasional comment on points where 1910 was materially different.

Verification runs.—Before the cards were used for the tabulation of actual data for publication, they were run through tabulating machines (one machine in 1910, machines in 1920) wired to "reject" cards that were off-gauge or otherwise mechanically imperfect, cards with inconsistent items punched in them, cards requiring completion by writing on them additional details for later hand tabulation, and some cards with items occurring very infrequently and thus assumed to be subject to question. The verification runs of 1910 and 1920 were similar to corresponding runs made in 1900, though with much less emphasis on the rejection of less frequent items solely for verification. Note above (p. 96), for example, the rejection for verification in 1900 of all foreign born in certain southern States.

Partly because the verification runs represent an element in tabulating which has been gradually crowded out in developments subsequent to 1920 and partly because there is no generally available source from

758-612 O - 65 - 11

Digitized by Google

which one can get specific information on this subject (as one might get fairly satisfactory information on data tabulated, from the published reports), the 1920 instructions for handling the verification run are reproduced in full.

Instructions for Card Verification—Individual Card

Cards are rejected on the machine verification run for being insufficiently punched (that is, without one hole in each field) or for being incorrectly punched; and many are rejected for purposes of verification, or for writing on the card information which could not be provided for by means of a punched hole.

In order that all cards may be properly verified and corrected, it is very essential that card verifiers become thoroughly familiar with the instructions for editing and punching.

Cards for each enumeration district, whether rejected on the first or second machine verification run, are to be arranged numerically, and *read back to the schedule*, the separation by minor civil divisions being maintained, and the separation by sex being restored before the cards are replaced in the boxes.

When a rejected card is found to be correct, a check mark (√) must be made over the punch in the field or fields for which the card was rejected.

When a card is found to be incorrectly punched, a cross mark (X) must be made over the incorrect punch, and the proper punch must be encircled.

In writing information on cards rejected for that purpose, it is very important that such information be written in that field of the card to which it relates.

The number of the card verification clerk is to be written on the back of each rejected card, whether found to be correct or incorrect.

The causes for rejection are specified below, and rejected cards are to be examined and corrected or verified in accordance with the specific instructions for each field.

A card may be rejected for more than one cause, and is, therefore, to be examined carefully in *each* field.

Rejections

Cards with one or more fields in which there is no punch. (Item, or items, to be punched must be circled in blue pencil.)

Family and tenure—"X" cards in family field punched other than "X" in tenure field. "DH1" or "DH2+" cards if punched "X" for tenure. (Cards rejected for either of these causes are incorrect and the proper punch according to the schedule is to be encircled.)

Color or race.—"W" cards if punched "Chi" or "Jap" (place of birth) and "F" (nativity). "Ch" cards unless punched "Chi" (place of birth) and "F" (nativity). "Jp" cards unless punched "Jap" (place of birth) and "F" (nativity). "B," "Mu," and "In" cards if punched "F" (nativity). "Fil," "Hin," "Kor," and "Ot" cards.

(Rejected for verification. If incorrect, encircle proper punch. If found to be correct, check color, place of birth and nativity, and *list* each card in full detail on Form 9–585. On the "Ot" cards write the race as given on the schedule, and in listing these cards enter such race instead of Ot.)

Age.—"100+" cards. (If found to be correct, write exact age on card and *list* on Form 9–585.)

"Un" cards (If correct, check Un.)

Unit "5" cards unless punched "0 mos" or "6 mos" in left-hand part of field. "0–0" cards, that is, cards punched "0" in both tens and units part of field. (Cards rejected for either of these causes are incorrect, and the proper punch according to the schedule is to be encircled.)

Digitized by Google

Marital condition.—"M," "Wd," "D," or "Un" cards for males under 20 years of age. "M," "Wd," "D," or "Un" cards for females under 15 years of age. (Rejected for verification. If found to be correct, check sex, age, and marital condition.)

Year of immigration.— "Un" cards (Rejected for verification. If found to be correct, check "Un" and also "F" (nativity), as "Un" year of immigration must be "F.")

"X" cards if punched "F" (nativity). Any year of immigration if punched "N" (nativity). (Cards rejected for either of these causes are incorrect, and the proper punch according to the schedule is to be encircled.)

"'19," "'18," "'17," "'16," or "'15" cards for persons 20 years of age and over punched "Na" (citizenship). (These cards must be carefully verified, as under the law a person should be in this country 5 years before obtaining final papers of naturalization. These cards may be correct for married women whose husbands are native, and who have thus become naturalized through marriage and not through papers.)

Citizenship—"Un" cards. (Rejected for verification. If correct, check "Un" and also "F" (nativity), as "Un" citizenship must be "F.")

"Pa" or "Al" cards punched "N" (nativity). (Cards rejected for this cause are usually incorrect, and the proper punch according to the schedule is to be encircled. A card may be correctly punched "Al" and "N" provided it represents a married woman born in the United States but whose husband is an alien. If such is the case, check "Al" and "N.")

School attendance and literacy.— "Yes" cards punched "YN" or "NN" (literacy). (Cards rejected for this cause are incorrect, and the proper punch is to be encircled. Persons attending school must be "YY" in literacy.)

"Yes" cards for persons under 5 or over 29 years of age. (Rejected for verification. If found to be correct, check age and school attendance.)

Place of birth of person.—All cards in this filed punched OP, Atl (F), Eu(F), OAs (F) and OWI (F). (Rejected for verification and for writing on card the country as reported on schedule. Check punch, if correct.)

"NS" (N) and "Ab" (N) cards. (Rejected for verification. If found to be correct, check punch. Cards punched "NS" must represent persons born in the United States (State not specified) or of unknown birth; cards punched "Ab" must represent persons reported as American citizens, or a person who is foreign born with both parents native.)

Mother tongue of person.—"X" cards if punched "F" (nativity). Any mother tongue if punched "N" (nativity). "LC" cards if punched in combination with any of the following places of birth: "1," Fr, Ger, Szd, A–L, B&H, C&S, J–S, Lit, Po–A, Po–G, Po–R, SA, and Slk. (Cards rejected for these causes are incorrect, and the proper punch according to the schedule is to be encircled.)

"OL" and "Un" cards. (Rejected for verification and for writing on card the language as reported on schedule.)

Place of birth of father.—"OC" (N) cards. (Rejected for verification and for writing on card the country reported on schedule.)

"Un" cards. (Rejected for verification. The birthplace of father should be punched "Un" only when the person himself is native (N); when the person is foreign born the birthplace of the father, if unknown, is to be punched the same country as the person.)

Mother tongue of father.—"X" cards if punched other than "U.S." (birthplace of father). Any mother tongue of father, if punched "U.S." (birthplace of father). "LC" (N) cards if punched Fr, Ger, or Szd (birthplace of father). (Cards rejected for these causes are incorrect, and the proper punch according to the schedule is to be encircled.)

"OL" (N) and "Un" (N) cards. (Rejected for verification and for writing on card the mother tongue of father as reported on schedule.)

Digitized by Google

Place of birth of mother.—See place of birth of father, and apply instructions to birthplace of mother.

Mother tongue of mother.—See mother tongue of father, and apply instructions to mother tongue of mother.

Nativity and parentage.—All rejected cards are to be verified in the nativity and parentage fields, and checked if found correct, or the proper punch encircled if new card is to be punched.

Following are the correct punches for the several combinations of nativity and parentage:

Birthplace of person	Punch	Birthplace of		Punch
		Father	Mother	
Any State of the United States, Alaska, Hawaii, Porto Rico, Philippine Islands, Guam, American Samoa, Panama Canal Zone, or Virgin Islands of the United States.	N	OC to Wa----	OC to Wa----	BF
		OC to Wa----	US or Un----	FF
		US or Un----	OC to Wa----	MF
		US or Un----	US or Un----	BNU
Any Foreign Country----------	F	OC to Wa----	OC to Wa----	BF
		OC to Wa----	US----------	FF
		US----------	OS to Wa----	MF

Whether able to speak English.—"No" cards if punched "N" (nativity). (Rejected for verification. If found to be correct, check punch.)

Most of the cases calling for the completion of a card by writing on it additional detail involved either place of birth (of person or father or mother) or mother tongue. For there was, especially in 1910, extensive reliance on this method for getting the figures for the less important countries and mother tongues.

In 1910 several of the items requiring this kind of completion were indicated by leaving the field unpunched. For example, for a strictly minor race, like Korean, nothing would be punched in the color or race field, the card would reject for this reason, and the specific race would be written on the card, as a part of the verification. This card would likewise reject in the first regular tabulation and the written-in data would be tabulated by hand and added to the machine totals.

As an indication of the machine wiring required to produce the rejections listed, the machine specifications for the first of the two 1920 verification machines are presented below. The second machine was devoted mainly to problems in connection with the returns for parentage and mother tongue. (Only one machine was used in 1910, as the parentage symbols in 1910 were much simpler.)

Digitized by Google

Machine Verification: 1920—First Machine

Field of card	*All cards, whether N or F*	*Cards punched N (native)*	*Cards punched F (foreign)*
All fields	Reject cards without one hole in each field.	----------	----------
Tenure	Reject X unless punched X in dwelling field also.	----------	----------
Color or race	Reject Fil, Hin, Kor, and Ot.	Reject Ch and Jp.	Reject W if punched Chi, Jap, in place of birth field. Reject B, Mu and In. Reject Ch unless punched Chi in place of birth field. Reject Jp unless punched Jap in place of birth field.
Age	Reject 100 and Un. Reject unit 5 unless punched 0 Mos or 6 Mos.	----------	----------
Marital condition	Reject M, Wd, D, and Un for males under 20 years of age. Reject M, Wd, D, and Un for females under 15 years of age.	----------	----------
Year of immigration.	----------	Reject any punch except X.	Reject X and Un. Reject '19, '18, '17, '16, and '15 for persons 20 years of age and over punched Na citizenship.
Citizenship	----------	Reject any punch except X.	Reject Un.
School attendance and literacy.	Reject Yes unless punched YY in literacy field. Reject Yes for cards punched under 5 or 30 and over in age field.	----------	----------

Digitized by Google

The verification machines carried a simple set of 10 counters on which were recorded the data by color or race. This provided, since the cards were sorted by sex as part of the punching process, data by color by sex for enumeration districts, from which could be derived figures for townships and other minor civil divisions. These were frequently used as a source for special transcripts, at least in 1920 and years shortly thereafter.

The 1920 machine verification, which required running the cards through two machines, was begun in April, 1920, and completed in November, involving 107 million cards, most of them handled twice.

The work of examining, verifying, and correcting the rejected cards occupied a force of from 250 to 445 clerks for the period from April to November. The whole number of rejected cards handled by this force amounted to nearly 17 million (or about 16 percent of the whole number of cards), of which number about 8 million cards had to be repunched or replaced by others correctly punched.[3]

First count, 1920—Detail for small areas.—In preparation for the first count the cards for ED's were first consolidated into the areas for which the tabulation was to be made, namely, urban places of 2,500 or over, wards for cities of 50,000 or over, wards and tracts for cities of 500,000 or over, and the rural [4] part of each county. Then, within each of these new areas, the cards, already sorted by sex, were sorted by color or race, the cards for native white were sorted on the parentage symbols found in the last column of the card, along with the N and F for nativity, making three groups: Native parentage (BNU), foreign parentage (BF) and mixed parentage (FF and MF, combined). The sort packs were then arranged, for each of the new areas, first by sex, then by color-nativity, considered as one series, as indicated below.

	Color	*Nativity*	*Parentage*
Males, by color-nativity, as follows:			
Native white—native parentage	W	N	BNU
Native white—foreign parentage	W	N	BF
Native white—mixed parentage	W	N	FF, MF
Foreign-born white	W	F	
Black	B		
Mulatto	Mu		
Indian	In		
Chinese	Ch		
Japanese	Jp		

[3] Statements with respect to the time consumed in the various operations are based on the *Annual Report of the Director of the Census* for 1921, dated September 15, 1921, pp. 8–10.

[4] Note that in 1910 was established the definition of rural population as that living outside incorporated places of 2,500 or more, which continued in force with only minor changes for 40 years. This (1910) was the first year in which there were any tabulated (detailed) data for rural and urban areas. Both tabulation and publication of data for rural and urban areas were considerably expanded in 1920, along with the adoption of the subdivision of the rural population into rural-farm and rural-nonfarm.

Digitized by Google

Males, continued:
- Filipino ..... Fil
- Hindu ..... Hin
- Korean ..... Kor
- Other[5] ..... Ot[5]

Females—same

In this count there was a single result slip for males in each area and another for females. Each sheet would accommodate the 13 color-nativity groups on 13 lines in each of the 4 sections, with 40 counters recording the data on what amounted to forty 13-line columns.

The tabulating machine for the first count was set up as follows, the symbols in parentheses indicating punch positions wired:

	Counter
Total number of cards	1
Dwellings and families:	
Not a head—wired for mechanical reasons, to clear field (X)	2
First head in dwelling—number of dwellings (NH–1)	3
Other heads of families—additional families (DH–2)[6]	4
Tenure of home:	
Not a head—wired for mechanical reasons, to clear field (X)	5
Home rented (R)	6
Home owned—free (OF)	7
mortgaged (OM)	8
unknown (OUN)	9
Unknown proprietorship (Un)	10
Age and school attendance:	
Under 1 year (0 Mos, 6 Mos)	11
1 to 4 years (0)	12
5 years: attending school (5–0[7]; yes)	13
not attending school (5–0; no)	14
6 years: attending school (5–1; yes)	15
not attending school (5–1; no)	16
7 to 9 years: attending school (5–2, 3, 4; yes)	17
not attending school (5–2, 3, 4; no)	18
10 to 13 years: attending school (10–0, 1, 2, 3; yes)	19
not attending school (10–0, 1, 2, 3; no)	20
14 years: attending school (10–4; yes)	21
not attending school (10–4; no)	22
15 years: attending school (15–0; yes)	23
not attending school (15–0; no)	24
16 and 17 years: attending school (15–1, 2; yes)	25
not attending school (15–1, 2; no)	26
18 and 19 years: attending school (15–3, 4; yes)	27
not attending school (15–3, 4; no)	28
20 years: attending school (20–0; yes)	29
not attending school (20–0; no)	30

[5] These cards were rejected and the specific races, written on the card, were hand tabulated; then the cards were counted by switch.

[6] The sum of counters 3 and 4 represents the total number of families, which is classified by tenure on counters 6 to 10.

[7] Cards punched 5 in main age field and 0 in units field, etc.

Digitized by Google

	Counter
Age and school attendance, continued:	
21 to 44 years (20–1, 2, 3, 4; 25; 30; 35; 40)	31
45 years (45–0)	32
46 years and over (45–1, 2, 3, 4; 50; 55; etc., to 100+)	33
Unknown age (Un)	34
Age and literacy:	
10 to 15 years: literate (10; 15–0; YY)	35
illiterate (10; 15–0; YN; NN)	36
16 to 20 years: literate (15–1, 2, 3, 4; 20–0; YY)	37
illiterate (15–1, 2, 3, 4; 20–0; YN, NN)	38
21 years and over: literate (20–1, 2, 3, 4; 25;etc., to Un; YY)	39
illiterate (20–1, 2, 3, 4; 25; etc., to Un; YN, NN)	40

This count was begun in September, 1920, and completed in February, 1921, using from 17 to 21 machines for most of this period.

Second count, 1920—Country of birth for small areas.—Retaining the areas of the first count, the foreign-born white cards (sorted by sex) were counted in the second count, as follows:

By citizenship, naturalized, first papers, alien, and unknown, for persons under 21 years of age and 21 years and over, separately.

By country of birth, in detail (without age).

By parentage—a simple count of the three parentage symbols representing foreign parentage; that is, BF, FF and MF.

In 1910, the tabulation by citizenship was limited to foreign-born males 21 years old and over, though including both white and colored. Citizenship data for foreign-born colored were obtained in 1920, for larger areas, in the fifth count. In the reports for both 1920 and 1910 major stress was placed on the citizenship of foreign-born whites.

This count was begun in December, 1920, and completed in February, 1921.

Third count, 1920—Single years of age, etc.—After the completion of the second count, the cards were consolidated for later counts into considerably larger areas, as follows: Each city of 25,000 or over was kept separate, but wards of cities of less than 50,000 were consolidated; two urban groups were formed in each State, one composed of the places of 10,000 to 25,000, and one of the places of 2,500 to 10,000, consolidated from the respective counties; the rural areas of the counties comprising a State were consolidated to form the rural area of the State. These areas, about 500 in number, were maintained for the remaining counts of the individual card.

For this count the cards, retaining the sorts by sex and by color-nativity, except that black and mulatto (B and Mu) were combined, were next sorted by age in accordance with the primary age symbols on the card, as follows: 0–5 months; 6–11 months; 1–4 years; 5–9 years;

Digitized by Google

etc., by 5-year intervals to 100-plus; then the groups 15–19 and 20–24 were sorted into single years from 15 to 20, with 21–24 as a residual. This sort was done in three stages, as it required the use of three columns on the card: First, the cards were sorted on the first age column which produced ages under 50 in 5-year periods; then the remaining cards, about 13 percent of the total, were sorted into 5-year periods by running on the second age column; and finally, the two periods 15–19 and 20–24, comprising about 18 percent of the total, were sorted on the age-units column to provide single-year groups for ages 15, 16, 17, 18, 19, and 20. The six single-year groups specified were provided in order to produce data on both school attendance and marital status by single years of age from 15 to 20.

This count, by reason of the very large number of packs of cards to be run, recorded, and the results consolidated, was the most complicated of the runs, though perhaps not more difficult than the sixth count, with its interlocking lists of birthplace and mother tongue.

Two machines, with different combinations wired, were provided for this count.

First machine.—The first machine, used for cards representing population under 21 years of age and population 35 years old and over, was wired to count the following combinations:

Literacy, YY, YN, and NN, with no relay combinations.
Ability to speak English, Yes, No, with no relay combinations.
Age and school attendance (unit of age only, the basic 5-year group was in the sort).
Unit year 5—No (to register only when counting 0 mos. and 6 mos.)
Unit year 0—No
Yes
Unit year 1—No
Yes
Unit year 2—No
Yes
Unit year 3—No
Yes
Unit year 4—No
Yes
Marital conditions, S, M, Wd, D, Un, with no relay combinations.
Farm population, Fm (living on farm), Ot (not living on farm).[8]

This machine used only 24 counters, out of a possible maximum of 60. Single years within the 5-year age periods represented by the "main"

[8] This was the only tabulation in 1920 of the classification, farm population, and nonfarm population. The resulting figures were published in ch. 15 of Vol. V of the 1920 Reports on *Agriculture* and later, in much more detail, in Census Monograph, VI, on Farm Population.

Digitized by Google

sort were obtained by adding the two school attendance groups counted for each age unit.

Second machine.—The second machine for the third count used the remaining cards, those representing ages 21 to 34 years, with counters set up as follows:

Literacy, YY, YN, NN, with no relay combinations.
Ability to speak English, Yes, No, with no relay combinations.
School attendance, Yes, No, with no relay combinations.
Age and marital condition:

Unit year 0—S	Unit year 2—same
M	Unit year 3—same
Wd	Unit year 4—same
D	Farm population, Fm (living on farm), Ot
Un	(not living on farm).
Unit year 1—S	
M	
Wd	
D	
Un	

This machine used 37 counters. Single years of age within the 5-year periods represented by the main sort on this run were obtained by adding the five marital-condition groups counted for each age unit.

The two machines differ in that, on the first machine, the school attendance item was distributed in the wiring by unit years, and on the second machine, the marital status item. Presumably it was decided that to put both of the combinations (with unit age) on the same machine would overload the machine; hence the device of the single-year sort for this period in the age series.

Granting that these combinations would really overload the machines, in spite of the fact that more complicated wirings were carried on similar machines, say, in 1930, one might suggest that one profitable alternative would have been to set up still a third tabulating machine, for unit age and school attendance only, like the section so designated on the first machine, for two 5-year packs of cards, those from 15 to 24, and run them on this machine. This would have been no more work than the sorting; and the trouble of keeping track of all the additional sort-detail for sections where it was not needed would have been saved, along with the hundreds of thousands of consolidations. Or even more simple, the cards for these ages could have been run on machine No. 2 as well as on machine No. 1 to provide the marital status data to supplement those provided on the existing second machine sheets.

The sorting of the cards for the third count was begun in January and completed in May of 1921. The count itself was completed in June of 1921.

Digitized by Google

Fourth count, 1920—State of birth.—For the fourth count all cards except those for foreign-born white were used. The detailed age sorts of the third count were consolidated into two groups, under 21 and 21 years and over. The sorts by sex and the parentage classes within the native white group were retained. (There were three parentage classes in 1920, native, foreign, and mixed, as compared with two classes in 1910, native and foreign-or-mixed.) It may be noted that no figures were *published* for State of birth by sex or for the two age groups, nor was there any publication of the data for native colored other than Negro, though figures for all the colored classes were required to make up the figures for total native.

These cards were tabulated on a 60-counter machine, wired to count State of birth, with the States arranged in the now standard geographic order, followed by 4 counters for the 4 parentage classes provided in the last column of the card for native population.

Since the cards for the two colored classes were not sorted by nativity, the machine was wired to reject foreign-born (F) Negroes, Indians, and Filipinos and the rejected cards were laid aside for tabulation on the fifth count. For the remaining colored classes, Chinese, Japanese, etc., the cards were run *first* on the fifth count machine, which was wired to reject the relatively small numbers of native persons (N); and these rejects were run on the fourth count machine, and consolidated with the other native classes.

Fifth count, 1920—Country of birth, large areas.—For the fifth count the cards remaining from the third count, representing foreign-born white persons, were consolidated into two age groups, under 21 and 21 years and over, as with the native cards, keeping the sort by sex.[9] Then each of the resulting card packs was sorted by citizenship—Na (naturalized), Pa, First papers Al, Alien and Un, Unknown or not reported.

The cards resulting from this sort were then tabulated on a 60-counter machine wired for countries of birth, with 11 counters reserved at the end for year of immigration, though the data for year of immigration by citizenship were never published. At the beginning (rather than at the end) of the series of countries was a residual group of countries for which the cards were rejected, presumably for hand tabulation of less important countries written in.

The cards for foreign-born colored persons were likewise consolidated into two age groups, under 21 and 21 years and over, and without

[9] The count by country of birth was made by sex, both in 1910 and 1920, through the sex classification was not presented in the 1910 report; and even in 1920 the presentation was limited to U.S. totals (with 1910 figures resurrected for comparison).

Digitized by Google

further sort (retaining the sort by sex and individual race) were tabulated on a special machine wired to count the following:

Naturalization: Na, Pa, Al, Un.
Ability to speak English: Yes, No.
Parentage: BF (both foreign), FF (father foreign), MF (mother foreign).
Year of immigration: 1919, 1918, etc., as punched in card.
Country of birth: 17 specific countries and a residual group to be rejected and presumably hand tabulated.

This machine provided for rejecting any card punched N (native). These cards, after being verified, were eventually added to the count of native persons by State of birth.

Sixth count, 1920—Mother tongue and parentage.—The 1920 specifications for the sixth count called for cards separated by sex throughout the rather complex series of tabulations. No separate figures for males and females appear in the report, however; and the sex classification would not seem to add enough to the significance of the data to justify the added cost of handling the cards for males and females separately.[10]

The first section used only the cards for native whites with both parents foreign born (punched both N and BF in last column on card). These were first sorted by mother tongue of father, then each of the resulting packs was sorted by mother tongue of mother. The cards showing the same mother tongue for both parents, including cases where the mother tongue was written on the card, were placed first in the arrangement for tabulation, followed by the cards for persons of mixed mother tongue; that is, for example, with father of French mother tongue (Fr) and mother of German (Ger), etc., all in one pack at the end.

These cards were run on a machine wired for place of birth of father and mother in combination, as follows:

	Counter
Total number of cards	1
Can-Can	2
Eng-Eng	3
Sc-Sc	4
etc. to	
Mex-Mex	22
All other[11] to reject and finally count on	23

The rejected cards were sorted, for each mother tongue, according to the countries written on the cards, and all cases of same country for father and mother were hand tabulated; the cards for mixed parentage were counted and the total entered as a single item. These cards were reserved for a later tabulation of birthplace of father by birthplace of mother.

[10] Two separate manuscript sets of specifications call for distribution by sex; but it is possible that this was dispensed with, at the last moment. This tabulation came at the end of the series and was extremely complicated, even without the added detail of sex.

[11] Including OC-OC, Un-Un, and all cards showing mixed countries, as Au-Fr, etc.

Digitized by Google

The second section of the sixth count used the next of the parentage groups from the standard nativity-parentage sort, the cards representing native whites with father foreign and mother native, or vice versa (N–FF or N–MF). These were sorted first on mother tongue of father; and the X cards (father native, mother foreign) were sorted on mother tongue of mother. This sort would separate (except for stray unusual cases) the cards punched FF from those punched MF; these two groups were kept separate, for separate tabulations.

The FF cards were arranged according to mother tongue of father, including cards with mother tongue written on, and tabulated on a machine set up for birthplace of father, as follows:

	Counter
Total number of cards	1
Can	2
Eng	3
Sc	4
etc. to	
Mex	22
All other (OC and Un) to reject and be finally counted on	23

The rejected cards for each mother tongue were sorted by birthplace of father and hand counted.

In the third section of this count, the MF cards were likewise arranged according to mother tongue of mother and tabulated on a machine similarly wired for birthplace of mother.

The fourth section of the sixth count used the foreign-born white cards only. These were sorted by mother tongue of person and each mother tongue counted on a machine wired for country of birth of person, following closely the pattern of the second count.

The fifth (and final) section of the sixth count used the cards for native whites of mixed foreign parentage as they came from the first section of the count. All mother tongues were first consolidated, then the cards were sorted by birthplace of father, including a hand sort of the OC (other country) cards with specific country written on them. The cards for each father-birthplace were then counted for birthplace of mother, using the machine set up for the third section of the sixth count, already wired to count birthplace of mother.

These figures were published (in the chapter on foreign white stock)[12] for 45 countries, of which number about one-half came from hand tabulations on the basis of countries of birth written on the cards. Note that with the adoption of 2-figure codes for place of birth in 1930 (providing codes for as many as 144 countries in a 2-column code, or for 48 States and 96 countries) the time-consuming task of rejecting cards for infrequently occurring items and hand tabulating them on the basis of countries written on the card was eliminated. (See p. 165, below.)

[12] *Fourteenth Census of the United States, 1920*, Vol. II, Population, p. 900.

Digitized by Google

The tabulation of occupations.—Following a machine verification similar to that outlined above for the population cards, the 1920 occupation cards, already sorted by sex, were sorted by occupation and two tabulations were made on machines wired to show, in combination with the occupations, various demographic classifications, such as color-nativity, marital status, and age—all of these, of course, by sex.

These tabulations were completed at about the same time as the last tabulation of the general population data, so that the occupation reports were ready for publication without the delay experienced in earlier censuses.

Digitized by Google

Chapter VIII. THE 1930 CENSUSES

CHANGES BETWEEN 1920 AND 1930

The 1930 key punch—First stage.—The major change in machinery and equipment between 1920 and 1930 was the adaptation of the population card to the commercial punch. This took place in three stages.

The first stage might better be designated an attempt to adjust the standard key punch to a population card following the same general pattern as the 1920 card, with five columns in which there were two or three fields and, on the other hand, several fields which occupied two, three, or five columns.

The guide plate of the familiar pantograph punch (see figure 12), carried as many designations as there were punch positions on the card, each individually labeled. Since the standard key punch, often called the commercial punch, had only 12 keys, 10 of them carrying the numerical digits, 0 to 9, the machine was provided with a guide card, with printed symbols corresponding to the symbols on the punch card. This was set up above the keyboard and moved along with the card carriage as the card was punched. Projecting down over the guide card and fixed to the bed of the machine was a position indicator, on the edge of which were printed figures corresponding to the figures on the keys. As the card moved forward under the metal plate these figures came into position opposite the symbols in the next column of the guide card, thus indicating the key to strike in order to punch the desired position. This machine is shown in figure 49, with the guide card in position for punching the first column. The position indicator, black with white figures, thus appears at the extreme left of the guide card, but will move forward with respect to the guide card as the punching progresses; or strictly, the guide card will move to the left under the position indicator, so that successive columns appear adjacent to the indicator.

The first-stage guide card was set up as indicated in figure 50, following, of course, the pattern of the population card first proposed for the 1930 census.

In order to adapt the machine to the variety of column assignments incorporated in the proposed card, the automatic spacing mechanism was omitted, so that the operator had to space the card, by striking a space key, whenever the program required that the card be advanced to the next column. This permitted the punching of two or three holes in

Digitized by Google

a single column, for the multifield columns, and also the special spacing required to bring the card into proper position for the single punch in a multicolumn field. Thus, after punching sex and color in column 6, the operator would strike the space key to bring the card forward into position for punching the 5-year period under age, in column 7, if age was under 50, then 2 spaces (skipping column 8, in which would be



FIGURE 49.—Commercial punch with guide card. The guide card in the machine, as illustrated, is the card used in the second stage of development, as outlined below, as witness the three columns (for occupation) at the end of the card. The schedule in the schedule holder is one of the 1920 schedules which were used in experimental work—and in the testing of the several stages of the adaptation.

punched the 5-year period if age was 50 or over) to punch unit year of age. Since marital condition was in the same column with unit age, it was punched without further spacing. Then a space to bring the card into position for year of immigration in column 10.

The problems involved in punching this card were made more difficult by the fact that even where there was a figure on the punch card, it was not to be gotten by simply striking the key carrying that figure. For example, unit-year 3 (or 8) was punched, not by striking the "3" key, but by striking the "2" key, after looking at the guide card and finding 3 on the card set against 2 on the indicator.

Digitized by Google

Conversely, in the multicolumn fields, especially in the 5-column field for place of birth (columns 12–16) the puncher had to find out in which column the punch position was located, to bring the card into position for punching in that column, to note from the indicator what key to strike in order to punch the card, and then to add enough more spaces to bring the card into position for the next field. Thus, even with the guide card, this machine required much more thinking on the part of the punch operator than did the old pantograph punch.

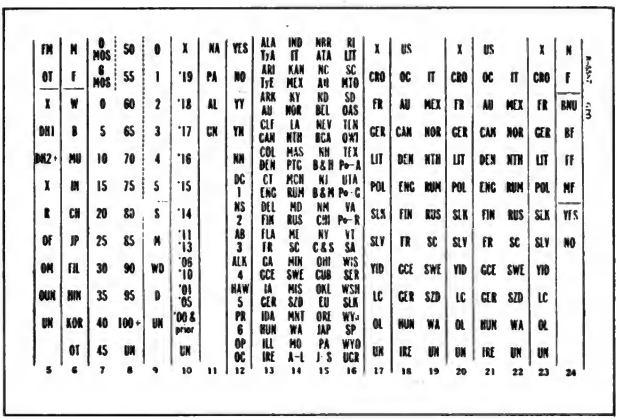


FIGURE 50.—First-stage guide card. On the printed guide card the symbols for States (for native population) were printed in red, to distinguish them from the alternative symbols for foreign countries (for foreign born); and a few other symbols of frequent occurrence were also in red. It is not practicable, however, to show this distinction in the reproduction here.

Even with the new card, as finally redesigned to fit the commercial punch, the punching of the cards on the 12-key punch was far more complicated, requiring more thinking and closer attention on the part of the punch operator, than the so-called Powers punch, used for the major part of the cards in the census of 1910. But that particular machine offered mechanical difficulties sufficient to discourage the Census mechanical force from further experimentation with it—though these difficulties have long since been eliminated in the punch currently used in the Remington-Rand system, the major early competitor with IBM in the commercial field.

Digitized by Google

Second stage.—The second stage in the adaptation of the punch card to the 12-key punch is represented by the guide card illustrated in figure 51, to be used, of course, with a punch card following exactly the same pattern.

In this card the multifield columns were eliminated, and at the same time the automatic spacing of the machine was restored, thus saving the punch operator from the burdensome task of spacing—and the more burdensome task of deciding when to space or when not to space.

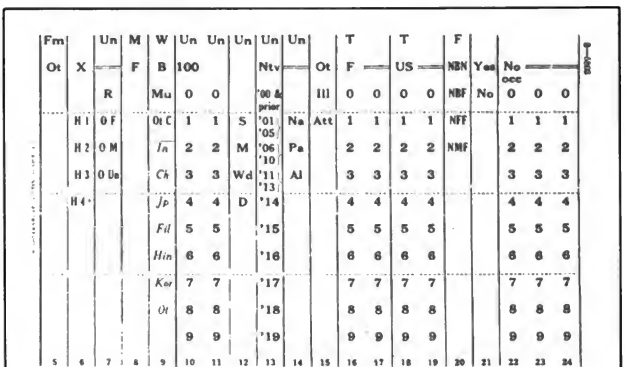


FIGURE 51.—Second-stage guide card

Then two radical changes were introduced. First, ages were to be punched in tens and units, as reported, instead of in 5-year periods and their units. This made the punching of age much easier, as the puncher had only to note what was reported on the schedule and punch it on the keyboard. In the total procedure there was some offset to this simplification, in that a few more relays were required in the machine wiring—of which more later.

Then provision was made for coding all of the returns on place of birth, mother tongue, and general nativity.[1] These codes, which were written in special code columns on the schedule, were punched in 5 columns on the card, in place of the 12 columns which these items occupied on the first-stage guide card, or on the 1920 punch card. To offset this tremendous simplification in the punching there was of course, the labor of complete coding, though it must be remembered that a considerable amount of coding in these fields, especially for the

[1] Note that place of birth was coded, and punched in two fields, in 1890.

Digitized by Google

foreign stock, was required under the 1920 (and earlier) procedures. Further, in the new procedure, code symbols were provided for *all* items required, thus eliminating the time-consuming process of rejecting the less frequent items, writing them on the card, and later again rejecting the card and hand tabulating the marginal items.

Then the two fields previously allotted to school attendance and illiteracy were combined into one 3-position field. And a 3-column field was provided for occupations, for which there had been no space at all on the first-stage guide card—or on the 1920 population punch card. And as a minor point, the column for year of immigration was inverted, so that the positions for the especially significant single years, 1914 to 1919, were punched by keys with the same final digit: 1916 in position 6 (in place of position 2), 1917 in position 7 (instead of position 1), and so on; and the four combination periods were at least arranged in descending order, on keys "0" to "3."

Test of the new card.—On the basis of the second-stage arrangement of material, cards were printed and an extensive test was instituted, through the use of selected 1920 schedules. The punching of these cards was completed on December 15, 1928, well before the census date. A total of 156,648 cards were punched in 502 hours, making an average of 312 cards per hour, or 2,184 in a 7-hour day, with a maximum above 3,000 for the best single day's work for one operator.

This record is considerably better than the record of the actual work on the 1930 census, partly because the three operators employed in the test were more efficient than the average of the whole force engaged on the much larger job. This force averaged, however, at the peak of the work, 1,791 cards per operator per day, which may be compared with a similar record of 864 cards per operator per day in 1920, on the pantograph punch.[2]

Of the cards punched in the test, 121,462 (omitting the cards for one whole area) were verified, with records per day somewhat above those for punching. By reason of difficulties growing out of the form of the 1920 schedules, to which the new procedures had not been completely adjusted, the records of errors made are not numerically significant. But the report made at the end of the test embodies the forecast that the punching in 1930 would be more accurate than that of 1920, if all of the cards were verified (as they actually were).

Changes required in machine wiring.—One objection vigorously raised when it was first proposed, in 1919, to punch the population cards on the commercial punch, was that the changes required to adapt the card to a strictly numerical pattern, as required by the commercial punch, would demand greatly increased complexity in the machine wiring, and increased numbers of relays.

[2] *Annual Report of the Director of the Census, 1931*, p. 5.

Digitized by Google

This objection did not hold with respect to the card finally adopted for 1920; or at least there were gains in some items to offset the requirement of additional relays for other items.

One case where the pantograph-type card would be simpler for tabulation would be a combination of 5-year age periods with some other item, like marital condition. This combination would require two relays with the 1930 card, as against one with the 1920 card (which rather laboriously assigns a separate punch position to each 5-year period). But the tabulation of marital condition by age was done, both in 1920 and in 1930, with the cards *sorted* into 5-year age packs; and sorting was quicker with the 1930 card than with the 1920, requiring only two runs through the sorting machine, rather than three (or perhaps two and a half, as only a part of the cards would require the third run).

The most extensive area of difference between the two cards, the 1920 pantograph card and the 1930 key punch card, was in the fields for place of birth and mother tongue. Each place of birth or mother tongue was represented by *one* punch position in 1920,[3] but by *two* positions in combination in 1930. But the usual machine setup for country of birth in 1920 and earlier censuses had counters for place of birth only, not in any combination, so the 2-digit symbols could have been handled with only one set of relays. But in the actual tabulations of 1930 the cards were always *sorted* by place of birth (or mother tongue). The sort for place of birth, if made on the 1920-style card, would have required sorting on five columns, as the punch positions were scattered over this range on the pantograph card, whereas with the 1930 card, only two sorts were required. Or even better, if the cards for the entire population had been run (sorted) on card columns 12 and 13, the result of this one run would have been the native cards sorted by State of birth and the foreign born by mother tongue. Actually, these sorts were not made for all classes combined, but for the native cards by state of birth and the foreign born by mother tongue. And likewise, on card columns 14 and 15, the foreign-born cards were sorted by country of birth, and the native of foreign or mixed parentage by "country of origin"; that is, country of birth of father for those with foreign-born fathers, plus those with native fathers by country of birth of mother.

Third stage—The 1930 card.—The changes between the second stage in the adaptation of the population card to the 12-key commercial punch and the third stage, which represented the card actually used in the 1930 census, were mainly in content rather than in arrangement.

---

[3] Except that the number of punch-positions assigned to mother tongue was so small that many of them had to be written on the card, to be rejected by the tabulating machine for hand tabulation, whereas the 1930 card provided individual code numbers for all, even those least frequently reported.

Digitized by Google

The items on tenure and household head in relation to dwelling were omitted, to be taken care of on the family card, in order to provide space for occupation-industry and class of worker. The resulting guide card and the final punch card are shown in figures 52 and 53.

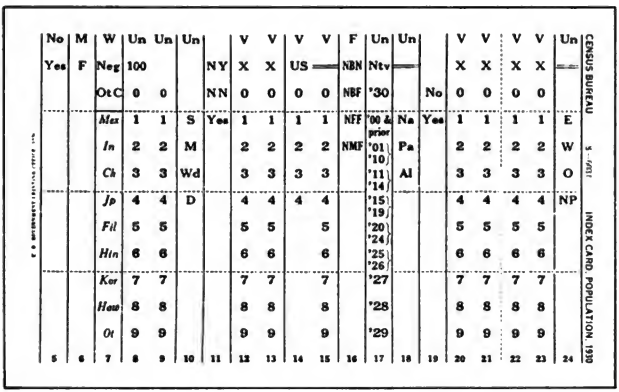


FIGURE 52.—Third-stage guide card

Note one added feature in the printed cards, in that the columns are *numbered* across the bottom of the card—a feature which makes simpler and more effective the writing of instructions for handling the cards in all stages of the work. And on the punch card there is also a brief "label," indicating the subject punched in the column.

Minor changes in the various fields included the following: In column 7, the symbols were changed to correspond with the color classes carried on the 1930 schedule; Neg took the place of B and Mu; and Mex (Mexican) and Haw (Hawaiian) were added to take care of additional classes.

In the actual punching, provision was made for a special procedure with the races other than white and Negro. The "regular" card for these races was punched OtC, and *in addition* a pink card was punched, identical except that the minor race alone was punched in the color column, and that the pink cards for Indians carried special codes for tribe and blood (whether full or mixed), punched in columns 14, 15, and 16.

These pink cards were tabulated by themselves to show all needed detail for the so-called minor races, thus doing away with the laborious and time-consuming process of rejecting cards for hand tabulation on the

Digitized by Google

basis of written-on designations, which had formed a part of the tabulation program in 1890, 1900, 1910, and 1920.

The three symbols for illiteracy and school attendance combined, brought over from column 21 to column 11, represented, respectively, Not attending school, but able to read and write (NY), Not attending school and Not able to read and write (NN), and Attending school (Yes). Note that this combination did not increase the complexity of the puncher's task, since earlier punchers had had to remember that all persons attending school were to be punched as literate in the literacy field.

The symbols for occupation-industry occupied four columns, two for occupation and two for industry, thus providing for a two-way classification of gainful workers, as in 1910, with a final column for class of worker. An extensive checking of the returns for this last column, in relation to the returns for occupation, indicated that, while they were better than in 1920, they were still not sufficiently accurate to justify detailed tabulation. They were often of material assistance, however, in the classification of the occupation returns.

The problem of identification of card with schedule entry was handled approximately as it had been in 1920 and earlier.

The various new proposals involved in the development of the new punching procedures were adequately tested, through the use of a rather large group of 1920 schedules, as indicated above. This explains why the guide cards designated first-stage and second-stage, were made up with items (for example, year of immigration) corresponding to the entries on the 1920 schedule. This experimental work covered not only the punching of the cards but also the wiring of tabulating machines. In the matter of machine wiring it may be noted that the objections raised, in connection with the pre-1920 tests, against such changes as the punching of tens and units for age or two positions for place of birth were overcome—or at least reduced to such an extent that they did not overbalance the savings in punching.

Even in the punching of the test or experimental cards from the 1920 schedule it soon became evident that the punchers, after the first few days of training, made little use of the guide card, since they soon learned the keys corresponding to most of the uncoded schedule entries. The last series to be memorized was year of immigration, which, of course, was required only for the foreign born; and even here it was only the six arbitrary groups that required effort, as the four single years tabulated were represented by their final digits. In fact, the operators soon asked to have the guide cards taken off their machines, since the card carriage seemed to run more smoothly without it. It may be granted, however, that the guide cards were very useful in the early stages of training.

Digitized by Google

The card, as finally adopted for 1930, it may be noted, required as a maximum only 20 key-strokes to punch it, including 5 strokes for a gainful worker, whereas the first-stage card required 40 strokes and did not cover occupations for gainful workers. Discounting 2 strokes for tenure and household head, which items were omitted from the final card, one might compare 38 strokes for the first-stage card, with hand-spacing, with 15 strokes for the final card, exclusive of occupations.

THE 1930 POPULATION SCHEDULE

The population schedule for 1930 followed closely the pattern of 1920, except for two very important innovations. First there was a new question asking for the value of the home, if owned, or the monthly rental, if rented—a question which met with considerable objection from those who felt that it went too far into the private affairs of the person enumerated. This question, introduced in connection with the traditional question on tenure, was expected to provide a rough index of economic status—a tentative forecast of the income question of 1940. Since this item was related to a family rather than to an individual, it was tabulated on the family card, rather than on the individual card. See under "The family card program," below.

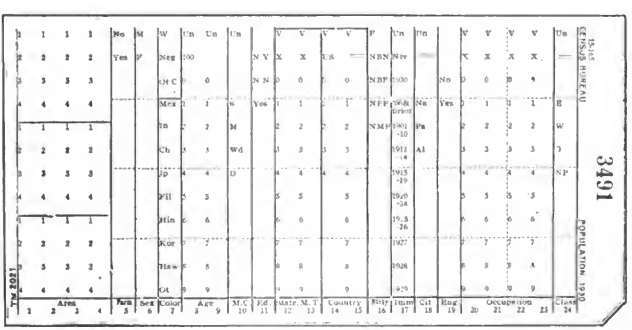


FIGURE 53.—1930 population card. See specifications for punching, p. 171

Then provision was made for the identification of all persons who might possibly be considered unemployed, for whom additional inquiries were to be made on a special supplementary unemployment schedule. For further information on this material, see the section on "The Unemployment Census," below.

Perhaps the question on radio set (Does the family have a radio set?) may well be counted as a third innovation, especially if it be regarded as

Digitized by Google

an entering wedge, so to speak, for the long list of questions on home characteristics which were embodied in the 1940 Census of Housing. This question, like the questions on tenure and value or rent, was punched on the family card.

The column headings on the 1930 population schedule, omitting most of those not used in punching the population card, were as follows:

10. Does this family live on a farm? (Yes or No)
11. Sex
12. Color or race
13. Age at last birthday
14. Marital condition
15. Years married—reserved for family card
16. Attended school or college any time since September 1, 1929
17. Whether able to read *and* write
18. Place of birth of person
19. Place of birth of person's father
20. Place of birth of person's mother
21. Language spoken in home before coming to the United States

A. Code column for State of birth or mother tongue
B. Code column for country of birth (of foreign born or of parent of natives of foreign parentage)
C. Code column for general nativity (NBN, NBF, NFF, NMF)

22. Year of immigration to the United States
23. Naturalization
24. Whether able to speak English
25. Occupation
26. Industry

D. Code column for occupation and industry

27. Class of worker
28. Employment—whether actually at work yesterday (or the last regular working day)—Yes or No
29. If not, line number on unemployment schedule

One manifest improvement in the schedule, looking forward to the mechanics of tabulation, was the provision of special columns for the code symbols that were to be supplied before the cards were punched.

Code columns A and B each served a double purpose. The code numbers for States ran from 50 to 99, with X0 to X9 for outlying possessions, etc. These would be required only for native persons. The code numbers for mother tongue ran from 00 to 49, plus V0 to V8, the "V" numbers being used for the less frequently reported languages. These would be required only for foreign-born persons; thus there was no overlap, and the two sets of codes were entered in the same column (column A) and punched in the same pair of columns on the card. And in column B, the code for country of birth would represent, for a foreign-born person, his own country of birth; or for a native of foreign parentage, the country of birth of his foreign parent. These two codes

Digitized by Google

were punched in the same pair of columns on the card, one series being distinguished from the other by the symbols in card column 16—F for the foreign born and NBF, NFF or NMF for the native of foreign parentage. For the natives of native parentage (NBN), US (punch key X) would appear in card column 14, and no tabulation by country of birth or "country of origin" would be called for.

Specifications for punching.—The punching of schedule questions 10 to 17, in card columns 5 to 11, would seem to offer no problems. The next five card columns (12 to 16) were punched from codes written in code columns A, B, and C. The coding of these columns, from schedule questions 18 to 21, was somewhat complicated, but it accomplished the object of putting all the information previously punched in 11 columns into 5 columns, and at the same time translating it into figures for punching on the 12-key punch. A part of the coding, notably that involved in the codes for column C (nativity), represented work which had to be done, in earlier years, by the punching clerk—work much more appropriate for a coding clerk than for a puncher.

The main details of the coding process are summarized in the following table, taken from the 1930 instructions for coding:

	Column A	Column B	Column C
Person native:			
Both parents native	State of birth of person	Leave blank	Leave blank
Both parents foreign born	State of birth of person	Country of birth of father	Code "0"
Father foreign born, mother native	State of birth of person	Country of birth of father	Code "1"
Father native, mother foreign born	State of birth of person	Country of birth of mother	Code "2"
Person foreign born	Mother tongue of person	Country of birth of person	Code "V"
American citizen born abroad:			
Parents native	Code "X0"	Leave blank	Leave blank
Father native, mother foreign	Code "X0"	Country of birth of mother	Code "2"

Blanks in code columns B and C were uniformly punched "X," which produced "US" in the country-of-birth field (card column 14) and "NBN" (native, both parents native) in the nativity field (card column 16).

Code "V" in code column C called for striking the "V" key on the machine, which punched "F" (foreign born) in the nativity column on the card. Codes "0," "1," and "2" in column C indicated the

Digitized by Google

remaining three nativity classes, which, in combination with the country of birth in card columns 14 and 15 provided all the detail of earlier census reports, except that persons of mixed foreign parentage were all assigned to country of birth of father. There was, therefore, no possibility of tabulating persons of mixed foreign parentage by country of birth of father in combination with country of birth of mother. But after all, the main value of the returns on country of birth of parents was to provide a basis for the classification of the foreign white stock by country of origin. For this purpose the classification of persons of mixed foreign parentage by country of birth of father was definitely more satisfactory than the earlier classifications, in which all persons of mixed foreign parentage, forming 6 or 7 percent of the native element in the foreign white stock, were pushed out of the scheme of specific classification altogether and shown at the end of the list as a miscellaneous group, designated "Of mixed foreign parentage."

The next field, year of immigration, was punched without help from coding, except for irregular or inconsistent returns, which were coded to show exactly the number to be punched. This item otherwise required some "thinking" on the part of the puncher for the groups of years, "1900 and earlier," "1901–1910," etc., even with assistance from the guide card. The next two fields, naturalization and ability to speak English, hardly needed even the assistance of the guide card.

Occupation-industry was coded in schedule column D, and unsatisfactory entries in schedule column 24, class of worker, were corrected and coded by the coding clerk. These last five card columns required significant punches only for gainful workers, who represented less than 50 percent of the population. For a person not reporting an occupation, however, the punching instructions called for the punching of a series of "X's"—partly because the use of "X" in some of the occupation symbols made it impracticable to use a skip device actuated by the "X" key to release the card for a nongainful person.

Automatic gang punch.—The rather cumbersome hand-operated gang punch used in earlier censuses was replaced by an automatic self-feed machine completed in 1928, which had a capacity of 600 cards per minute, with a maximum of 12 holes punched in each card.[4]

Details of Machine Tabulation, 1930

First count—Data for minor civil divisions.—There was no count in 1930 devoted solely to verification, as there had been in earlier censuses; but the first count, made by ED's without further sorting and providing data for publication by minor civil divisions (townships, etc.), contained provision for rejecting many of the inconsistent combinations taken care of by the more extensive verification runs of 1920.

[4] *Report of the Director of the Census, 1928*, p. 5.

Digitized by Google

No complete list of these combinations is available, but provision was made, in particular, for the rejection of cards showing inconsistencies between the nativity-parentage symbols in card column 16 (F, NBN, NBF, NFF, and NMF) and the symbols in various columns representing other classifications, such as naturalization or mother tongue or year of immigration; and for as many other probable inconsistencies as the capacity of the relay system on the tabulating machine would permit.

The verification work, aside from the actual rejection of inconsistent or off-gauge cards, was very much reduced, as compared with even 1920. No cards representing merely unusual cases, like age 100 (or age not reported) were rejected for checking against the schedule; no cards for marginal classes, such as infrequently reported countries of birth, were rejected to have a specific designation written on the card for later use; and there were no rejections from either this count or any later count, for hand tabulation—this last partly because *all* countries of birth and *all* mother tongues were provided with their specific symbols and thus taken care of in the regular mechanical process.

The first count machine carried 18 significant counters, giving the following items, which were published, with a slight rearrangement, by minor civil divisions, in table 21 for each State, in Volume III of the 1930 Reports on Population.

Color and nativity:
- White—native of native parentage
- White—native of foreign or mixed parentage
- White—foreign born
- Negro
- Other races

Sex:
- Male
- Female

Farm residence:
- Farm
- Nonfarm

Age:
- Under 5 years (0–4)
- 5–14 years
- 15–20 years
- 21–24 years
- 25–34 years
- 35–44 years
- 45–64 years
- 65 years and over
- Unknown

This count provided the first classified data ever published for townships and other minor civil divisions—still another of the innovations of the 1930 census.

Second count—Age, school attendance, and marital condition.—For the second count the ED's were consolidated into larger geographic areas as follows: Cities of 50,000 or over by wards or by tracts for selected cities, places of 2,500 to 50,000, each place separately, balance of each county (rural territory). This last area was sorted on farm residence, making two quasi-areas, rural farm and rural nonfarm. These last two quasi-areas, which were maintained for most of the tabulations except the detailed occupation tabulations, might be considered to represent one more important innovation in the 1930 census.

Digitized by Google

The areas indicated above were sorted, first by sex, then by color-nativity, making the following possible sort-groups for each area—10 packs of cards for each area:

Male:
- Native white, native parentage
- Native white, foreign or mixed parentage
- Foreign-born white
- Negro
- Other races

Female:
- Native white, native parentage
- Native white, foreign or mixed parentage
- Foreign-born white
- Negro
- Other races

The cards were then tabulated on a machine wired for the following detail:

Age and education:
- Under 1 year (0–4)
- 1–4 years
- 5 years: Attending school
  Not attending school
- 6 years: Attending school
  Not attending school
- 7–9 years: Attending school
  Not attending school
- 10–13 years: Attending school
  Not attending school, literate
  Not attending school, illiterate
- 14 years: Attending school
  Not attending school, literate
  Not attending school, illiterate
- 15 years: Attending school
  Not attending school, literate
  Not attending school, illiterate
- 16–17 years: Attending school
  Not attending school, literate
  Not attending school, illiterate
- 18–19 years: Attending school
  Not attending school, literate
  Not attending school, illiterate
- 20 years: Attending school
  Not attending school, literate
  Not attending school, illiterate
- 21 years and over: Attending school
  Not attending school, literate
  Not attending school, illiterate
- 21–24 years
- 25–29 years

Digitized by Google

Age and education, continued:
- 30–34 years
- 35–44 years
- 45–54 years
- 55–64 years
- 65–74 years
- 75 years and over
- Unknown

Nativity and parentage:
- Native, native parentage
- Native, foreign or mixed parentage
- Foreign born

Marital condition (for persons 15 years old and over):
- Single
- Married
- Widowed
- Divorced
- Unknown (marital condition not reported)

The detailed tabulation of age, illiteracy, and school attendance was much the same as in 1920. The detailed ages from 21 to 75 took the place of a much shorter series of age groups used for the county-and-city tabulation in 1920. The 10-year groups from age 35 represented a compromise with recommendations calling for 5-year groups from 25 to 75. The tabulation of marital condition for small areas was new, and seemed to satisfy a wide demand, in spite of the fact that marital condition for age 15-plus as a unit, without further subdivision by age, is often difficult of interpretation.

Except for a few minor consolidations, practically the whole detail of this count was published by States (with some supplementary figures from the seventh count) and for urban, rural-nonfarm, and rural-farm areas in the States; color-nativity by age by sex was published by counties and for cities of 10,000 or more; selected items, in a list occupying a full column of stub in the table, were published by counties and again for cities of 10,000 or more; and a shorter list of selected items was published for rural-nonfarm and rural-farm parts of counties and for urban places of 2,500 to 10,000, all in Volume III of the 1930 Reports on Population.

Third count—Country of origin.—The geographic areas for the third count were the same as for the second count. These areas, often referred to as "small areas," comprised the larger cities by wards or tracts, the smaller cities, and the rural area of each county classified as farm and nonfarm.

In the third count only two of the five color-nativity classes of the second count were used, namely, the foreign-born white and the native white of foreign or mixed parentage—the classes constituting the foreign white stock.

Digitized by Google

The sort groups for each area thus comprised these classes by sex, arranged as follows:

Foreign-born white: Male
Female
Native white of foreign or mixed parentage: Male
Female

The first section of the tabulating machine, as wired for this count, was set up to show citizenship (naturalization) for persons under 21 and persons 21 and over, occupying 8 counters. This, of course, was significant only for the foreign-born group. The remainder of a 60-counter machine carried a somewhat condensed list of countries of birth. These counters recorded, for the foreign born the country of birth of the persons themselves; and for the natives of foreign or mixed parentage, the country of birth of father—or of the foreign-born mother, where the father was born in the United States.

Country of birth for the foreign born was tabulated by counties, wards, and tracts in 1920, and it is reported that of all the tract material used by the 1920 tract cities, this was the most valuable and the most widely used. In the 1930 reports, the figures for counties and cities were published for selected lists of countries, ranging from 20 in States with a small foreign-born element to around 30 in States like Pennsylvania and New York.

The tabulation by counties of the second generation of the foreign white stock by country of origin (country of birth of parents) was new in 1930. This expansion was justified by the fact that in many States, particularly in the rural Northwest, where the stock was mainly German or Scandinavian, the first generation was already becoming unimportant, so that any significant indication of the European origins of the population had to be based on the country of birth of the parents.

The figures indicating country of origin were published in the 1930 reports for counties and for cities of 10,000 or more, but not for the rural parts of counties, nor for the farm and nonfarm areas.[5]

The citizenship figures, however, were published not only for counties and 5,000-plus cities, but in condensed form (total foreign born and naturalized) for the rural-nonfarm and rural-farm population of each county.

Fourth count—Gainful workers by industry.—For this count the geographic areas of the second count were retained, though figures were published only for counties, without classification as rural farm and rural nonfarm, and for cities of 25,000 or over. Within each of these areas the sort by sex was retained, but the sorts for color-nativity were consolidated, except that color (white and nonwhite) was kept for the

[5] See tabels 9, 18, and 19, for each State in Vol. III of the 1930 Reports on Population.

Digitized by Google

southern States. The cards for each area were thus arranged for tabulation as follows:

For a northern State:	Male
	Female
For a southern State:	White male
	White female
	Colored male
	Colored female

For the southern States a special tabulation of the pink cards for non-Negro colored was also made later and the results were subtracted from the figures for total colored to provide the figures for Negroes alone, which were published.

The tabulating machine was set up for 56 industries or industry groups, with counters also for nongainful persons 10 years old and over and for persons under 10, since the cards for all persons were included in the run.

For each State as a whole, the complete list of industries as tabulated was published, with figures also for urban, rural-nonfarm, and rural-farm areas in the State, but for counties and for cities of 25,000 and over the industry list was considerably condensed; and there were no urban-rural or farm-nonfarm distinctions. This count, it may be noted, represents the first tabulation of data for gainful workers by counties, or by farm and nonfarm residence.

The presentation of gainful workers classified by industry for counties might be considered another major innovation in the 1930 census publication program.

Fifth count—Country of birth and mother tongue.—The geographic areas for this count, sometimes referred to as the "large areas," were as follows: Each city of 25,000 or over, separately, with statistical areas for 7 tract cities, cities of 10,000 to 25,000 combined for each State, urban places of 2,500 to 10,000 combined for each State, rural-farm population of State, rural-nonfarm population of State.

The fifth count used only one of the color-nativity groups, namely, the foreign-born white. Retaining the sort by sex, these cards were sorted by country of birth and tabulated on a machine wired, first for citizenship by age (under 21 and 21 years and over) and then for mother tongue, with counters for the complete list of about 36 mother tongues, involving some permanent consolidations of items separately coded.

The cross-classification of mother tongue by country of birth was published in fairly full detail for the United States, but not for any smaller geographic areas, even in condensed form. The data for mother tongue alone, however, were published not only for States and cities, but also for urban, rural-nonfarm, and rural-farm areas within States.

The citizenship counters on this count provided the material for the

Digitized by Google

chapter on citizenship in the general report of the 1939 census of population.[6]

It may be noted that in 1930 the question on mother tongue was asked only of the foreign born; hence the limitation of the data to this class. In 1910 and 1920 the inquiry covered the entire foreign white stock, including natives of foreign parentage.

Sixth count—Marital condition, illiteracy, etc, by country of origin.—For this count, using the same areas as for the fifth count, the cards for natives of foreign or mixed parentage were sorted by country of birth of significant parent (father, if foreign born, or mother if father was born in the United States), and arranged in a series parallel with that of the foreign born already sorted by country of birth for the fifth count.

These two groups of cards were tabulated on a machine wired to cover the following classifications:

Marital condition of persons 15 years old and over.
Parentage in detail—Both parents foreign (NBF), Father foreign (NFF), Mother foreign (NMF).
Ages 0–4 and 5–9
Literacy by ability to speak English, by age:
10–14 years: Literate, able to speak English.
Literate, not able to speak English.
Illiterate, able to speak English.
Illiterate, not able to speak English.
15–24 years—Same.
25–44 years—Same.
45–64 years—Same.
65 years and over—Same.
Year of immigration for the foreign born.

This count provided the material for the following sections of the General Report on Population:[7] All of chapter 9, Year of Immigration; the special tables on country of origin in chapter 11, Marital Condition, and in chapter 13, Illiteracy; and for the major part of chapter 13, Inability to speak English.

Seventh count—Single years of age, etc.—The geographic areas for this count were the same as those specified above for the fifth count. The count used all cards, consolidating the countries for those representing the foreign white stock, as used in the fifth and sixth counts, and taking also the color-nativity classes laid aside at the beginning of the fifth count; that is, the native white of native parentage (NBN) and the two colored classes (Neg and Ot).

The sex sort was retained, together with the original sorts by color, nativity, and parentage, arranged as for the second count.

Under the sex-color-nativity-parentage classification each pack was sorted into 5-year age groups, making a possibility of 210 card packs for

[6] *Fifteenth Census of the United States, 1930*, Population, Vol. II, General Report, pp. 399–492.
[7] *Fifteenth Census of the United States, 1930*, Vol. II.

Digitized by Google

each area. Separate machines were set up for cards representing persons under 35 years of age, for part of whom cross-classifications by single years of age were required, and for persons 35 years old and over, for whom the 5-year age periods represented in the sort were considered sufficient.

The first machine, for persons under 35 years of age, was set up with counters as follows:

Total number of cards	1 counter
Single years of age (within the 5-year period); that is, 0/5, 1/6, 2/7, 3/8, or 4/9 in the units column of the age field	5 counters
Marital condition by single years of age	25 counters
School attendance and literacy by single years of age, set up as in the second count	15 counters
Nativity and parentage (F, NBN, MBF, NFF, NMF)	5 counters

Number of counters, 51

The second machine, for persons 35 years of age and over, carried a much simpler array of counters, as follows:

Total number of cards	1 counter
Single years of age	5 counters
School attendance by literacy	3 counters
Marital condition	5 counters
Nativity and parentage	5 counters

Number of counters, 19

From this count were obtained the detailed age statistics for chapter 10 on age distribution in Volume II of the 1930 Reports on Population; the detailed statistics on school attendance and illiteracy by age, for chapters 12 and 13, respectively, in Volume II; the really adequate statistics of marital status (classified by age) for the chapter on marital condition (chapter 10), and separate figures for native whites of foreign parentage and mixed parentage, by age, for the chapter on age distribution.

Eighth count—State of birth.—For this count the areas of the immediately preceding counts and the sort by sex were retained and likewise the nativity and parentage sorts of the white population, while the Negro and "Other colored" were sorted by nativity. The foreign-born white, as well as the foreign born sorted out from the colored classes, were laid aside, and the age groups were consolidated, leaving for this tabulation only the native cards, in 4 color groups, or only 8 packs per area, as contrasted with 210 in the seventh count.

These were tabulated on a machine wired for State of birth, using the machine up to its capacity of 60 counters (including 1 counter for total).

The results of this count were published in the chapter on State of Birth of the Native Population, chapter 4, in Volume II of the Fifteenth Census Reports on Population.

The remaining counts.—The ninth count was a special count of nongainful persons (represented by the cards laid aside from the sort

Digitized by Google

for occupations) 10 to 24 years of age by school attendance by age, for supplementary use in connection with the occupation counts.

The tenth count was made only for cities of 25,000 to 100,000, and showed, by sex, gainfully employed persons in 213 occupational groups.

The eleventh count was made for each city of 100,000 or more separately, and for the balance of each State. The cards were sorted by sex, color-nativity, and occupation (434 occupations or occupational groups) and tabulated on a machine to show age, in the following groups:

10–13 years	17 years
14 years	18–19 years
15 years	20–24 years
16 years	and 5-year periods to 75 years and over

and marital condition of women 15 years old and over (three classes, single, married, and widowed or divorced) in the following age groups:

15–19 years	35–44 years
20–24 years	45 years and over
25–34 years	

The twelfth count was made for cities of 500,000 or over, each city separately, and used only the cards for 134 "repeater" occupations. These cards, sorted by sex and occupation (134) were sorted also by industry and tabulated on a machine wired to show color-nativity and age in the following groups:

10–17 years	25–34 years
18–19 years	and for 10-year periods to 75 years and
20–24 years	over

The results of counts 10, 11, and 12 were published in Volumes IV and V of the Fifteenth Census Reports on Population.

THE 1930 UNEMPLOYMENT CENSUS

The 1930 Unemployment Census first identified all gainful workers who might possibly be considered as unemployed, through a general question (columns 28 and 29 on the main Population Schedule) separating out all gainful workers who were not at work "yesterday," and then recorded, on a special supplementary Unemployment Schedule, various items which would help to classify these individuals in one or another of seven carefully defined classes, no one of which was specifically labeled "unemployed."

The Unemployment Schedule.—This Unemployment Schedule covered the same geographic area as the Population Schedule; it thus formed a supplement to that schedule and was set up in similar form, with a line for each person represented and columns for the several items of information called for. The Unemployment Schedule contained 15 numbered columns for entries by the enumerator and 10 lettered col-

Digitized by Google

umns for codes and for items to be transcribed from the corresponding Population Schedule (plus three more columns, L, M, and N, designed for family data, but not used—except that column L was arbitrarily used for a code-classification of invalid or unacceptable cases). The headings for these columns were as follows:

Identification

2. Sheet number
3. Line number
4. Name of person

} For identification with entries on Population Schedule (Copied by enumerator from Population Schedule)

Work status

5. Does this person usually work at a gainful occupation? Yes or No
6. Does this person have a job of any kind? Yes or No

If this person has a job

7. How many weeks since he has worked on that job?
8. Why was he not at work yesterday (or on the last regular working day)?
A. Code for reason for not being at work
9. Does he lose a day's pay by not being at work? Yes or No
10. How many days did he work last week?
11. How many days in a full-time week?

If this person has no job of any kind

12. Is he able to work? Yes or No
13. Is he looking for a job? Yes or No
14. For how many weeks has he been without a job?
15. Reason for being out of a job
B. Code for reason for being out of a job
C. Classification, based on columns 6, 9, 12, and 13

For later transcription from Population Schedule:

D. Relationship to head of family
E. Sex
F. Color and nativity[8]
G. Age
H. Marital condition
I. Occupation
K. Class of worker

As compared with the unemployment questions asked in earlier censuses, this schedule, with its numerous questions, would seem to be unduly complex. Actually, it represents the first serious attempt to get really satisfactory statistics of unemployment—and the beginning of long-continued discussions with respect to the inclusion or exclusion of borderline cases, which represented a considerable fraction of the whole number of persons who might have been counted as unemployed under a simpler form of inquiry.

The major part of the information on unemployment was contained in either one or the other of the two main sections of the schedule set off

[8] Items transcribed included parentage for native white and ability to speak English for foreign-born white only.

Digitized by Google

under the headings "If this person has a job" and "If this person has no job of any kind." The maximum number of columns containing entries made by the enumerator on this schedule for any one person would be six. The first (left-hand) section covered most of those who would, offhand, be considered unemployed; the second (right-hand) section carried information regarding the considerable number of other persons who were not receiving income from their normal gainful activity for various reasons—these constituting most of the borderline cases mentioned above.

Transcription and coding.—Before they were ready for card punching, the Unemployment Schedules went through two processes. First, certain important items of information about the person concerned were transcribed from the Population Schedule, for the most part in the form of code numbers. In some cases a special series of codes was set up for use in this connection; for example, in column D of the Unemployment Schedule were entered the following codes for family relationship:

	Code
Head of related family	1
Head of one-person or "partnership" family	2
Related member of family	3
Lodger or other unrelated person	4

For publication this classification was condensed into three groups: (1) Head of family; (2) Related family member; and (3) Lodger, etc.

In column F were entered the following codes for color and nativity, with parentage for the native white and ability to speak English for the foreign-born white:

	Code
Native white, native parentage	1
Native white, foreign or mixed parentage	2
Foreign-born white, able to speak English	3
Foreign-born white, not able to speak English	4
Negro	5
Mexican	6
Chinese	7
Japanese	8
Other races	9

In the published reports, three of the special classifications based on the two code series just outlined, namely, family relationship, parentage, and ability to speak English, were presented only to a limited extent; that is, they were shown only for classes A and B (as described below), cross-classified by sex, by States and for large cities.

The codes for occupation, industry, and class of worker were transcribed into Unemployment Schedule columns I and K, as they appeared on the Population Schedule. The occupation-industry classifications were widely used, and in a number of combinations, especially by sex,

Digitized by Google

throughout the Unemployment Reports. There was no tabulation of the 1930 class of worker, however, either for unemployment or for total gainful workers.

Most of the coding on the Unemployment Schedule, aside from that required to make clear some of the less clearly written entries, was relatively simple. The coding in column C, on which was based the main classification of the data, however, was rather complicated. And since the classification punched in the cards did not correspond directly with the classes for which figures were published (being arranged for convenience in the tabulation rather than in any logical order) the tabular statement contained in the Instructions for Coding is reproduced here, with an additional column indicating the class in the final tables which each code number produced.

Schedule columns				Classification code	Description of class	Final class as published
Column 6	Column 9	Column 12	Column 13			
Yes	Yes	-------	----------	1	With job—idle without pay	B,D, or F[9]
Yes	No	-------	----------	2	With job—idle *with* pay	G
No	-------	Yes	Yes	3	Jobless—able to work and looking for a job	A
No	-------	Yes	No	4	Jobless—able to work but *not* looking for a job	E
No	-------	No	No or Yes	5	Jobless—unable to work	C
Invalid or unacceptable cases covered by special instructions[10]				9		

The unemployment card.—The 24-column unemployment card, partly keyed to column numbers on the schedule, is illustrated in figure 54. Note that, like the 1930 population card, this card carries at the bottom of each column not only the column number but also a brief "label," indicating the subject represented; and that only three columns are reserved for geographic areas.

Punching the card.—Perhaps the most important innovation in the specifications for punching the 1930 unemployment cards was the actual

[9] Cards carrying code "1" were subclassified in tabulation on the basis of entries in schedule column 8, Reason for not being at work, as follows:

Sick or disabled.....Class D
Voluntarily idle.....Class F
Other reasons.....Class B

[10] These are cases outside the most generous borderline, comprising persons with no occupation (that is, not gainful workers), unpaid family workers, permanently disabled, etc. For use in evaluating the returns, they were coded into nine classes in column L.

Digitized by Google

punching into the card of the "identification" data; that is, the information required to relate the card back to the Unemployment Schedule, or even to the corresponding Population Schedule from which a considerable part of its data were obtained. The first four hand-punched columns of the card were used for this purpose, putting the Population Schedule sheet number in card columns 4 and 5 and the line number in columns 6 and 7.

In card column 8, Weeks idle, the returns were punched either from schedule column 7 or from schedule column 14, according to whether the individual had a job (data recorded in left-hand section of the schedule), or was without a job (recorded in right-hand section of schedule). The code numbers of the significant groups of weeks were entered, in red ink, in the same column as the returns, since no separate code column was provided.

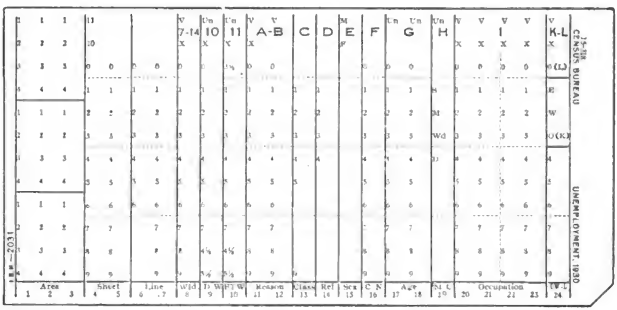


FIGURE 54.—Unemployment card, 1930

Card columns 9 and 10, Days worked last week and Hours in a full-time week, were punched for the most part as returned by the enumerator. For a jobless individual, for whom these columns would be blank, an X was punched in each column.

Card columns 11–12 were punched from schedule columns A or B, whichever contained an entry. The remaining columns were punched from coded entries in the columns indicated by the boldface letters at the top of the card.

In a case where there was a code in column L, this code was punched in unused parts of card column 24, even though a code for Class of worker had already been punched, from column K, in this card column.

The results of the tabulations of this card are presented in Volume I and Volume II of the 1930 Reports on Unemployment, to which the

Digitized by Google

reader is referred for information as to the details of the unemployment tabulations.

Summary cards.—A number of summary cards (or "total cards" as they were called at first) were used in the consolidation of the tabulated results of the unemployment census. These were 45-column cards into which were punched the area totals from the tabulation sheets (result slips) of the various runs, for tabulation on the adding tabulator—presumably on IBM machines, such as were being used for the census of agriculture. By way of illustration, the content of two of these cards may be summarized as follows:

Card No. 1: Col. 1. Class (cut in over part of the area field)
Col. 2. Sex (also cut in over area field)
Col. 3. Date, 1930 or 1931[11] (cut into occupation field)
Cols. 3–6. Occupation-industry
Cols. 7–10. Total
Cols. 11–14. Native white, native parentage
Cols. 15–18. Native white, foreign or mixed parentage
Cols. 19–22. Foreign-born white, speak English
Cols. 23–25. Foreign-born white, do not speak English
Cols. 26–29. Negro
Cols. 30–32. Mexican
Cols. 33–35. Other races
Cols. 36–37. Age 10–14
Cols. 38–41. Age 15–19
Cols. 40–45. Age 20–24

Card No. 2: Cols. 1–6. Same as No. 1
Cols. 7–45 carried the remainder of the age series.

From the tabulation of these two summary cards were obtained the consolidated results of the classifications of unemployment returns, classes A and B, by color and nativity and, independently, by age. There is no record of the number of square yards of consolidation sheets saved by this technique; but the area must have been very large. Nor is any record now available as to the number of other summary cards used, but this without doubt was also considerable.

The exploratory nature of the 1930 Census of Unemployment is evidenced by the presentation of the returns in seven classes, indicating, one might say, decreasing strength of claim to the status of being unemployed. The figures were uniformly designated "Unemployment Returns, Class A, Class B," etc., with no figure labeled "Unemployed." In fact, no figure in the published report was presented as representing

[11] See "The 1931 Census of Unemployment" below.

Digitized by Google

the unemployed. These classes, with the number in each class in 1930 (out of a total of 48,829,920 gainful workers) were as follows:

Class A. Persons out of a job, able to work, and looking for a job	2,429,062
Class B. Persons having jobs but on layoff without pay, excluding those sick or voluntarily idle	758,585
Class C. Persons out of a job and unable to work	172,661
Class D. Persons having jobs but idle on account of sickness or disability	273,488
Class E. Persons out of a job and not looking for work	87,988
Class F. Persons having jobs but voluntarily idle, without pay	84,595
Class G. Persons having jobs and drawing pay, though not at work (on vacation, etc.)	82,335

Significantly, the reports do not give any figures representing the sum of these seven classes.

The major classifications under which the unemployment data were presented, aside from the basic sex, color-nativity, and age, were occupation or industry, period of idleness, reason for idleness, and marital condition, with a special section on part-time employment. These detailed cross-classifications were for the most part limited to classes A and B.

The 1931 Census of Unemployment.—Partly by reason of adverse comment on the results of the 1930 Unemployment Census, a second unemployment census, following closely the same pattern, was taken in 18 selected urban areas, in January, 1931. The results of the 1931 Census of Unemployment were presented in Volume II, Unemployment, 1930, pages 361–600, with some discussion of the purposes of this special census and of the significance of the resulting figures, in comparison with the 1930 data for the same areas.

THE FAMILY CARD PROGRAM, 1930

For the rather detailed tabulations for families that were planned for 1930, there was provided a Family Transcription Sheet, to which were transcribed, from the Population Schedule, the required items of information. The family cards were then punched from this sheet, rather than directly from the schedule.

The Family Transcription Sheet.—The Family Transcription Sheet was set up in somewhat the same form as the schedule, only much smaller (12½ inches wide and 11 inches deep) with 17 columns and 32 lines, or enough to carry all the families transcribed from an entire schedule sheet. Figure 55 is an illustration of this sheet, somewhat reduced in size.

The columns were lettered, to facilitate reference in the instructions for transcription; and each column heading carried at the bottom a figure indicating the column of the Population Schedule from which would be obtained the information to be transcribed. For the most part, the items to be entered in these columns were clearly described by the column heading, though some comment may be in order in a few cases.

Digitized by Google

16-889
DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
Fifteenth Census
POPULATION

FAMILY TRANSCRIPTION SHEET: 1930

State..... E. D. No. .....

Card No..... Sheet No. .....

	Line No. (Population schedule)	A Tenure	B Value of home or rental	C No. of family in dwelling	D Related persons in family	E Lodgers and boarders	F Children under 21	G Children under 10	H Number of gainful workers in family	K Nativity (Head)	L Marital condition (Head)	M Age (Head at last)	N Occupation (Head)	Home-maker O Age	Home-maker P Age at marriage	Home-maker Q Employment	R Radio set	
		7	8	4	5-6	5-6	6-13	6-13	5-D	12-C	14	13	D	13	15	D	9	
1																		1
2																		2
3																		3
4																		4
5																		5
6																		6
7																		7
8																		8
9																		9
10																		10
11																		11
12																		12
13																		13
14																		14
15																		15
16																		16
17																		17

FIGURE 55.—Family Transcription Sheet, 1930. Actual size of sheet, 12½ by 11 inches

Digitized by Google

Column C called for the serial number, as 1st, 2nd, etc., of the family in the dwelling; this provided, in the tabulation, the number of 1-family dwellings, 2-family dwellings, etc., and also the total number of dwellings occupied by private families.[12]

Columns D, E, F, G, and H required the transcriber to count the numbers of persons of each type entered within the schedule area occupied by the family.

Column L, Marital condition of head, required the construction of a rather complicated code series, designed primarily for the tabulation of data on fertility—specifically, data on which might be based ratios of children to potential parents, classified by age and duration of marriage. These classes were as follows, based in part on the marital condition returned in schedule column 14, and in part on age and marriage duration, as shown in columns 13 and 15.

	Code
Single	0
Married, wife shown on schedule as homemaker; husband under 61, wife under 51; first marriage (duration of marriage same or within 1 year)	1
Married, under specified age, wife shown on schedule as homemaker; second marriage (duration of marriage differing by more than 1 year)	2
Married, over specified age or wife not shown on schedule as homemaker	3
Married, wife (or husband) not shown on schedule	4
Widowed	5
Divorced	6
Marital condition not reported	7

Column N, Occupation of head, called simply for the transcription of an occupation code already entered on the Population Schedule. Column Q, "Employment status of homemaker," however, required a completely new classification, based in part on the occupation returns, but under a special arrangement, to produce the following employment classes:

	Code
Not gainfully employed	X
Employed at home:	
Farmers and farm laborers (unpaid)	V
Other occupations at home	0
Employed away from home:	
Professional workers	1
Office workers	2
Industrial workers	3
Servants, waitresses, etc	4
Saleswomen	5
Other occupations away from home	6
Employed, not specified whether at home or not	7

[12] For boarding houses, hotels, institutions, and other quasi-family groups a special code was entered in column C, followed by entries of the population involved and a code for type of quasi-family in succeeding columns. These quasi-family groups numbered about 75,000, as against nearly 30 million private families.

Digitized by Google

The family card.—The family card, which was identified with the Transcription Sheet for possible future reference by printed serial numbers (just as the population card was identified with the schedule), carried at the top of each field the column number of the Transcription Sheet from which it was to be punched, as illustrated in figure 56.

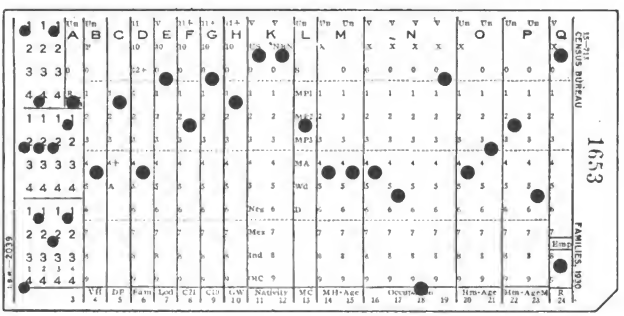


FIGURE 56.—Family card, 1930

On July 1, 1931, it was reported[13] that the transcription had been completed for 37 States, representing about half of the families in the United States, and that cards had been punched for 23 States, representing about one-fifth of the total number of families. With a nominal deadline of December 31, 1932, this would seem to represent a rather late start (probably not unrelated to the ambitious program undertaken), somewhat trailing the work on occupations; it was reported on July 1, 1932,[14] however, that both families and occupations were being published, in separate bulletins, State by State, and that summary reports as well as these State reports would presently appear in bound volumes.

The detailed tabulations of family data were limited to private families, omitting the small number of quasi-family groups (hotels, boarding houses, institutions, etc.), for which were tabulated only the total population involved and the type. So far as the machine work was concerned, there were eight counts in all, though the sixth count and the special count of secondary families covered only one geographic division, the East North Central.

The census tract count.—This count was made from the cards for private families in each census tract in the 18 census tract cities, without

[13] *Report of the Director of the Census, 1931*, p. 8.
[14] *Report of the Director of the Census, 1932*, p. 3.

Digitized by Google

further sorting. The counters on the tabulating machine were set up to count the following items:

Size of family
Home tenure, with value or rent for nonfarm homes
Color-nativity-parentage of family head, with country of birth for foreign-born white
Type of dwelling: 1-family, 2-family, and 3-plus family
Radio set, Yes or No

First count of families—Small areas.—The first of the "regular" counts was made for what were termed "small areas," that is, for counties and urban areas (including wards in large cities), sorted by color-nativity-parentage of family head and by tenure. From the cards, as thus sorted, the following items were tabulated on the first count, using the full capacity of a 60-counter machine:

Dwellings and families:
- First family in dwelling
- Second family
- Third family
- Fourth and later families

Radio:
- Having radio, farm family
- Having radio, nonfarm family
- Not having radio

Nonfarm families, by tenure and value or monthly rental of home:

Owner families, by value	*Tenant families, by rental*
Under $1,000	Under $10
$1,000–$1,499	$10–$14
$1,500–$1,999	$15–$19
$2,000–$2,999	$20–$29
$3,000–$4,999	$30–$49
$5,000–$7,499	$50–$74
$7,500–$9,999	$75–$99
$10,000–$14,999	$100–$149
$15,000–$19,999	$150–$199
$20,000-plus	$200-plus
Unknown (not reported).	Unknown.

Farm families, total number
Farm families by size: 1-person, 2, 3, 4, etc., to 12 or more, and by number of children under 10 years old: 1 child to 6-plus
Nonfarm families by size: 1-person to 12-plus, and by number of children under 1 year old: 1 to 6-plus

Second count—Family composition.—For the second count the areas were consolidated, retaining only cities of 25,000 or over, putting together all places of 2,500 to 25,000 in a State, and sorting the rural balance of the State into farm and nonfarm. The sorts by tenure and by color-nativity-parentage of head were retained, as in the first count.

Digitized by Google

The cards were then tabulated on a machine set up to give the following detailed classifications:

Age of man head: Under 25, then 10-year periods to 75-plus, with counters for age unknown and for families with woman head
Number of children under 21: None, 1, 2, 3, 4, 5, 6–8, 9-plus
Number of lodgers: No lodgers, servants; no lodgers, no servants; 1 lodger, 2, 3, etc., to 10 (a household with more than 10 lodgers was classified as a boarding house, not as a family)
Employment status of homemaker, as outlined above, for column Q on the Transcription Sheet, plus counters for no homemaker and homemaker not gainfully employed
Number of gainful workers in family: None 1, 2, 3, 4-plus

Third count—Foreign-born white families by country of birth of head.—For the third count the cards for families with foreign-born white heads were sorted by country of birth of head, and the cards for families of the minor races (which included Mexicans) were sorted by race. The areas of the second count were retained.

The tabulating machine was wired for the following items:

Families by size
Tenure and value or rent of home for nonfarm families (as in first count)
Farm families and families with tenure unknown (not reported)
Gainful workers: 1 to 4-plus
Children under 10 years old: 1 to 6-plus
Lodgers—as in second count

Publication.—The major part of the results of the first and second counts was published in the main report on Families for 1930,[15] while the results of the third count were published in a supplementary octavo volume entitled "Special Report on Foreign-born White Families by Country of Birth of Head." This last contained, also, in an appendix similar data for Mexican, Indian, Chinese, and Japanese families.

Fourth count—Families of gainfully employed homemakers.—For the fourth count of families the geographic areas were further consolidated, keeping each city of 100,000 or over, all cities of 25,000 to 100,000 in a State combined, all places of 2,500 to 25,000 combined, and the rural area, sorted into farm and nonfarm.

Since this count was to represent only white or Negro families with employment status of homemaker reported, the cards for minor races were laid aside, and likewise other cards not representing homemakers with employment status reported (including, of course, some without any homemaker).

The sort by nativity (but not parentage) of the white family heads was retained; each of these classes was sorted by employment status of homemaker, and each of the resulting classes by age of homemaker, from under 15 to 45-plus, in 5-year periods.

[15] *Fifteenth Census of the United States, 1930*, Population, Vol. VI, Families. (1933).

Digitized by Google

The tabulating machine was wired to count the following items:

Families classified according to number of gainful workers, partly in combination with family size, as 1 gainful worker, 1 person; 1 gainful worker, 2-person family; 2 gainful workers, 3-plus person-family; 3 gainful workers; 4-plus gainful workers
Families by size, 1 person to 10-plus persons
Families by number of children under 16 years old, partly in combination with size of family, as no children, 1-person family; no children, 2-person family . . . 1 child, 3-plus persons; 2 children; 3 children, etc. to 6-plus children
Marital condition of man head: Single; married, wife present; married, wife absent; widowed; divorced; unknown
Marital condition of woman head: Single; married, husband absent; etc.
Number of lodgers, as outlined above for second count

Fifth count—Type of family.—For this count were used the white and Negro cards as they came from the fourth count, including those discarded for lack of the requisite information on status of homemaker, but discarding those with no report on marital status of head. The geographic areas were further consolidated, keeping separate only cities of 250,000 or over,[16] and combining all other cities above 25,000 into one group for each State. The remaining areas, places of 2,500 to 25,000 as a group, rural farm, and rural nonfarm, were retained as in the preceding count.

The sort by color-nativity of head was retained; each class was then sorted by sex of head, then by marital condition, and finally by number of children under 21 years old.

For this decidedly complex sort, counters were set up, on two machines, to count the following items:

Tenure of home by value or rent
Age of man head, in 10-year periods
Size of family, to 9-plus
Gainful workers, to 4-plus
Children under 10 years old, to 4-plus
Lodgers, as in second count

Sixth count—Number of children by age of wife.—This count covered only a single geographic area, the East North Central Division (Ohio, Indiana, Illinois, Michigan, and Wisconsin), all the States thrown together, but keeping separate the following groups, which might be considered as representing degree of urbanization:

Cities of 250,000 or over, all combined
Cities of 25,000 to 250,000
Places of 2,500 to 25,000
Rural area

[16] Including, also, by special arrangement, New Haven, Syracuse, Yonkers, and Nashville.

Digitized by Google

Further, all cards not conforming to the following list of qualifications were laid aside, so as to avoid the disturbing element of incomplete or "not reported" classifications. In other words, the cards used in the tabulation had to have:

a. Family head white or Negro
b. Husband and wife living together
c. Present marriage presumably first marriage (difference between present age and age at marriage same for husband and wife, or within 1 year)
d. Husband under 61 and wife between 15 and 48, and
e. Value or rent of nonfarm homes reported, with farm homes to be counted as a single class

The nativity sort of the cards representing white families was retained from the fifth count, making, with Negro, three basic classes. Then each of these classes was sorted by value or rent of home, omitting the usual sort by tenure, so that owned homes valued at less than $1,000 were left combined with rented homes with rental less than $10, etc., to form, roughly, a classification by economic status; in this sort farm families formed a single supplementary class, at the end of the value-or-rent series.

Then, each of the value-or-rent classes was sorted by age of wife, in single years; and each of the resulting packs of cards was sorted by number of children under 10 years of age in the family. All of this, of course, made a tremendous number of packs of cards for each of the four geographic areas.

Finally, the tabulating machine was set up to count the following items:

Age of wife at marriage, by single years from 13 to 39
Employment status of homemaker (wife), as on second count
Age of husband, in 5-year periods, from 15–19 to 55–59

Count for secondary families.—There was, also, a supplementary count of secondary families, defined as families of husband and wife, with or without children, living within and counted as a part of another private family. For this count there was also the limitation that the husband must be under 61 and the wife between 15 and 48 years of age. This count was made from a special set of cards, based on salmon-card records made at the time of the family transcription, and, like the sixth count, it was made only for the East North Central Division.

The secondary family cards were tabulated, without sorting, on a machine wired to count the following items:

Children under 10
Employment status of homemaker-wife, counting separately those with no children and those with one or more
Age of wife, in 5-year periods
Color of head, with nativity for white heads
Number of gainful workers

Digitized by Google

Status of counts four to six.—By reason of lack of funds, in connection with other adverse conditions growing out of the depression, the last three of the main counts remained for the most part unpublished, though the counts had been finished and consolidation sheets completed, ready for the last stage of preparation for publication. As of this writing, the machine sheets have been preserved; and there is on file a microfilm of the rather voluminous consolidation sheets.

Parts of the material from these consolidation sheets were used to provide 1930 figures for comparative tables in three of the 1940 reports, as follows:

Population—Types of Families, 1940; p. 218
Population—Size of Family and Age of Head, 1940, p. 122
Population—Families—Employment Status, 1940, pp. 11 and 46

Digitized by Google

Chapter IX. NINETEEN FORTY AND LATER

THE SIXTEENTH CENSUS, 1940

The Census of 1930 marked roughly the end of the period of dependence on relatively simple procedures associated with relatively simple machine processes—the end of an era marked by the rather slow development of the Hollerith system and of its successors in the Census Machine Shop. Between 1930 and 1940 the main emphasis in the Census shop was on increasing the speed of operation of the sorting machine and the unit counter. But more important, perhaps, for the 1940 Census, was the introduction and increased use of various types of equipment commercially available, especially of IBM products—though IBM adding tabulators had been used in the tabulation of the census of agriculture since 1920, and for such summary cards as were used in 1930 and later. The 60-column recording sheet (result slip) of the unit counter still remained, however, the most efficient device for printing the results of machine operation available from any source.

The most important completely new type of equipment used extensively in 1940 was the reproducer—a machine which mechanically transferred items already punched in one card to another card and in any desired position on the new card. This machine might have been used, if it had been available, to punch the major part of the 1920 occupation cards, by transfer from the main population card, rather than repeating so many items (16 fields) by hand punching—*except* that without the punched identification of the cards (the punching of sheet and line number, as in 1940) which had not then been introduced,[1] the reproducer could not identify the cards concerned in its reproducing process.

One might, then, list the adoption of the 45-column card in 1940 as a major innovation in the matter of machine procedure, since this card made possible the punching of the identifying sheet and line numbers, which, in turn, made possible the use of the reproducer and of other types of commercial equipment. (Note that most of the IBM equipment of 1940 was designed for use with 45-column cards.)

[1] And could not have been with the 24-column card, since that card could not possibly spare the 4 columns necessary.

758-612 O - 65 - 14

Digitized by Google

Another important piece of IBM equipment used in 1940 was the printer-tabulator, which was of great service in summarizing the data from the unit-counter result slips. These figures were first transferred to summary cards through the use of manually operated key punches. Then the IBM machine would not only accumulate information from consecutive cards, but would also add items punched in different fields of the same card, to provide needed totals and subtotals, and print the same card, to provide needed totals and subtotals, and print the results approximately as they were needed for publication. This machine thus displaced the earlier process of copying the unit-counter result slips to consolidation sheets and obtaining totals and subtotals through the use of desk adding machines.

The initial reason for the adoption of the 45-column card was, of course, to provide space for additional fields—through the elimination of the cumbersome process of identifying the cards with their schedule sources through the numbers printed across the ends of the cards was considered an additional major advantage. Actually, however, under the less meticulous verification programs of 1940 and later, there was far less occasion for checking a card against the schedule entry which it represented than in earlier censuses, especially in those prior to 1930.

Introduction of sampling.—By far the most important single innovation in the 1940 Census of Population, however, was the introduction of sampling, in what then seemed like a safe and conservative form (with not the least preconception of the extent to which it would expand in the next 20 years).

To provide direct professional supervision, Dr. W. Edwards Deming, then a physicist in the Department of Agriculture, but with an understanding of sampling theory and an enthusiasm for it which had found expression mainly in the Department's graduate school, was coaxed away from the Department—with some not too definite implications to the effect that the Census Bureau's need for his services might be only temporary.

The 1940 sample was a 5-percent sample of the population enumerated. Its random selection was secured by indicating on each schedule page two "sample lines," designated by the words "Suppl. Quest.," printed in both left and right margins (two sample lines out of a total of 40 lines on a page). Then there was a miniature 2-line schedule at the bottom of the page, with column headings to indicate additional questions to be asked only of the two individuals whose names happened to fall on the sample lines in the main schedule. To assure the randomness of the sample, five different editions of the schedule were printed, with the sample lines differently distributed. This avoided, for example, the bias that would have resulted from a selection which either always included, or always excluded, the first line on the schedule.

Digitized by Google

The most important new (as compared with 1930 or 1920) and independent item assigned to these supplementary sample returns was perhaps the old-time, but so far ill-fated,[2] question on the number of children ever born to married, widowed or divorced women. This question was not only tabulated for 1940 but was supplemented by the tabulation of a comparable sample of the corresponding returns on the 1910 schedules, which were all on file in the Bureau, so that the 1940 reports show (subject to whatever allowances were sure to be demanded, in 1940, by reason of their sample-based nature) comparative figures for two census dates approximately one generation apart.

To the sample section were assigned also two familiar items of declining importance, place of birth of parents and mother tongue; two groups of questions urgently supported by noncensus agencies, those referring to veteran status and to social security experience; and a question on "usual occupation," of special significance at a time when "present occupation" might be one connected with some war emergency program.

The little 2-line schedule provided at the bottom of each main schedule page for these supplementary returns contained also a set of code columns for transcription of selected items from the main schedule, for convience in punching the cards for the sample persons.

With due regard for the size of the sample (5 percent), the tabulations were limited to relatively large areas, namely, States (urban, rural-nonfarm, and rural-farm), and large cities (250,000 and over, with more detail for cities of 1 million and over).

Elimination of age unknown.—Provision was made, as a part of the process of coding the population schedules, for the estimating of age for those few persons who had not reported this item, thus doing away with the very troublesome element of "age unknown" in the detailed cross-classifications involving age. The unreported ages were estimated partly on the basis of the ages of other members of the family, etc., and partly by well considered reference to a pack of "random" cards—a process well in accord with the newly adopted sampling policy.

New Inquiries in 1940

The 1940 Population Schedule carried a considerable number of new inquiries, some of them rather complex. Space for the tabulation of these was provided partly by the increased size of the card (45 columns in place of the 24 columns used up to and including 1930) and partly by transferring some of the old-time "standard" questions to the sample

[2] Note that this question got so far as to be punched in the population card in 1890 and in the family card in 1900, but failed of tabulation by reason of exhaustion of funds; see pages 82 and 116 above.

Digitized by Google

section at the bottom of the new schedule page. The new inquiries included the following.[3]

Education.—In place of the earlier question on literacy ("Can this person read and write?"), there was a question calling for the highest grade of school completed, with entries running by grades from first grade (1) to 4th-year college (C–4) and anything beyond (C–5). There was considerable opposition to this change from persons who objected to the omission of the familiar figures on illteracy. But for many population classes and in many areas the percentage of illiteracy had so nearly approached zero that changes or comparisons were no longer significant. And in favor of the change it was argued that the new question would give valuable information with respect to several levels of educational attainment, in place of the single not too definite point represented by stated ability to read and write, even with some allowance for inaccuracy in the returns on grade completed. The data secured through this question were considered highly satisfactory, though somewhat marred by the obvious return, in many cases, of the highest grade *attended*, rather than the highest grade *completed*. (Measures were taken in 1950 to eliminate this uncertainty.)

Migration.—As a basis for the tabulation of statistics of recent migration from one part of the United States to another, the 1940 schedule called for a report of each person's place of residence on April 1, 1935 (omitting, of course, persons under 5 years of age) in terms of specific urban place, county and State (or foreign country), and whether or not on a farm. The tabulation of previous residence, in these terms, in comparison with present (census date) residence, provided data on recent movement from one specific area to another, in great detail—which detail had, of course, to be much condensed for publication. This gave a measure of net migration from one specific area to another between two specific dates,[4] whereas the only migration data available from earlier censuses were limited to migration between date of birth, often many years or decades back, and the census date, and this only for States.

Employment status.—On the basis of experience with the unemployment censuses of 1930 and 1931 and employment surveys conducted during the 1930's, questions were formulated to provide similar data, in more definite form, for 1940. The problem was complicated by the fact that in 1940 many persons usually employed in gainful occupations were working on emergency-relief projects, which in general did not represent the equivalent of "real" employment. These persons formed a separate class in the final reports, as being neither "at work" nor

[3] The complete schedule, with enumerator's instructions, is reproduced at the end of Pt. I of Vol. IV of the 1940 Reports on Population.

[4] The data on migration between specific geographic areas were published in a special report entitled "Internal Migration, 1935 to 1940: Color and Sex of Migrants." Three other special reports classified migrants by age, and by economic and social characteristics.

Digitized by Google

seeking work—though in many respects their status was similar to that of those returned as seeking work. To meet these requirements, the following inquiries were added to the schedule:

21. Was this person AT WORK for pay or profit in private or nonemergency Government work during week of March 24–30? (Yes or No)
22. If not, was he at work on, or assigned to, public EMERGENCY WORK (WPA, NYA, CCC, etc.) during week of March 24–30? (Yes or No)

If neither at work nor assigned to public emergency work (No in cols. 21 and 22)—

23. Was this person SEEKING WORK? (Yes or No)
24. If not seeking work, did he HAVE A JOB, business, etc. (Yes or No)
25. For persons answering "No" to questions 21, 22, 23, and 24, indicate whether engaged in home housework (H), in school (S), unable to work (U), or other (Ot)
26. If at private or nonemergency Government work ("Yes" in column 21), number of hours worked during week of March 24–30, 1940
27. If seeking work or assigned to public emergency work ("Yes" in columns 22 or 23), duration of unemployment up to March 30, 1940 in weeks

In addition, there was a question, following the traditional questions on occupation and class of worker, asking for the number of weeks worked in 1939—this partly as an introduction to the income question which immediately followed.

There was also a rather important change in the age limits set up for the data on occupation and employment in that the questions were to apply only to persons 14 years old and over, rather than to those 10 and over, as in earlier censuses. This change was adopted on the assumption that employment or economic activity on the part of children 10–13 had so far declined as to be of little importance. This seemed particularly true in connection with the questions on unemployment. There was, of course, some objection to the change on the part of individuals and organizations working with the earlier figures on child labor; but even the 1930 census figures on gainful workers classified by age seemed to offer justification for the change.

The new concept of the labor force.—One other fundamental change, decidedly important, was that which based both work status and occupation on the situation in a specific period of time, the week of March 24–30, 1940, rather than on the rather indefinite concept of "usual" status. From this developed the concept of the labor force, defined in the main as comprising persons who were either at work or seeking work during a specific week, which from this time on has replaced the older concept of "gainful worker," defined as a person who "usually" worked at a gainful occupation.

Income.—The question on amount of income, though it was limited strictly to *wage or salary* income, was one of the most controversial of the new 1940 questions, even having a Congressional hearing devoted to it, in which Senator Tobey, for one, expressed vigorous opinions to the effect that such a question was a rank invasion of personal privacy, especially serious where the enumerator might be a personal acquaintance

Digitized by Google

of the enumeratee; and that the question would be sure to meet with refusals which would utterly vitiate the statistics based on such few returns as would be obtained, etc.

The limitation to wage and salary income doubtless helped to make the question acceptable. And to meet the objection just stated, it was provided that a person might report his income on a form to be sent, sealed, direct to the Census Bureau, rather than giving it to the local enumerator. Very few persons, however, took advantage of this arrangement; nor were the returns on income appreciably less complete than the returns on some of the "older" questions on the schedule.

The 1940 income question might be considered as a further development from the question on value or rent of home, of 1930, which met with similar objections when it was proposed in 1929. And a comparison of the income returns with the returns from the question on value or rent, which was repeated in 1940 on the housing schedule, verified the assumption that the earlier classification (value or rent) did serve to divide the various census groups into economic levels which roughly corresponded with the more specific income levels.

Supplementing the income question was a simple question as to whether the person had other income in 1939, that is, other than wages or salary amounting to $50 or more, to be answered Yes or No. Although its purpose in 1940 was to make it possible to identify those persons whose wage and salary income was effectively their total income, this question may possibly be considered as a "feeler," looking forward to the expansion of the income question in future censuses (as it was expanded in 1950), to include income from all sources.

The 1940 Tabulation Program

The preliminary sample card (card S).—The first use of the 5-percent sample entries was for the punching of a preliminary sample card, from which were secured early figures for the population of States and large cities classified by sex, color, broad age groups, employment status, and farm residence.

To provide these preliminary figures a special card was devised containing the geographic identification data and the schedule sheet number, with four fields, one for each of the four sample lines on a complete schedule, in which were punched sex, color, age, work status, and farm or nonfarm residence of the sample persons.

These cards were punched from a brief preliminary sample transcription sheet, prepared from the entries in the main part of the population schedule for the persons returned on the sample lines. The results of the tabulation of these cards, subject, of course, to the standard sampling error, were released nearly a year before the corresponding classifications were available from the tabulation of the "regular" population cards.

Digitized by Google

The main 100 percent population card (card A).—For each person returned on the population schedule was punched a 45-column card, as illustrated in figure 57.

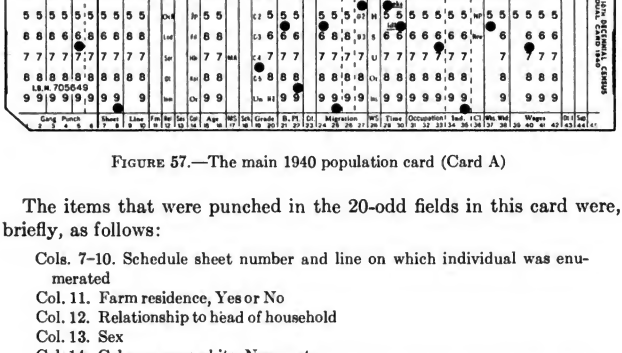


FIGURE 57.—The main 1940 population card (Card A)

The items that were punched in the 20-odd fields in this card were, briefly, as follows:

Cols. 7–10. Schedule sheet number and line on which individual was enumerated

Col. 11. Farm residence, Yes or No

Col. 12. Relationship to head of household

Col. 13. Sex

Col. 14. Color or race: white, Negro, etc.

Cols. 15–16. Age in months for persons under 1 year old; then by single years to 109–plus

Col. 17. Marital status: single, married, spouse present (that is, enumerated as member of same household); widowed, divorced, married, spouse absent (not enumerated as member of same household)

Col. 18. School attendance, Yes or No

Cols. 19–20. Highest grade of school completed

Cols. 21–22. State or country of birth

Col. 23. Citizenship of foreign born

Cols. 24–27. Migration. Place of residence in 1935. For nonmigrants, same house or different house. For migrants, State, subregion, and classification of place (by size, etc.)

Col. 28. Work status (during week of March 24–30),a s follows:

Persons in the labor force:

At work (Yes in schedule column 21)

Engaged in emergency work (Yes in schedule column 22)

Seeking work (Yes in schedule column 23)

With a job (Yes in schedule column 24)

Persons not in the labor force:

Housewives (H in schedule column 25)

Students (S in schedule column 25)

Unable to work (U in schedule column 25)

Not in labor force for other reasons (Ot in schedule column 25)

Inmates of specified institutions (Inmate, etc., in schedule column 8)

Work status unknown (not reported)

Digitized by Google

Items on card A, continued:

Cols. 29–30. Time: for persons at work, hours worked in week of March 24–30; for persons seeking work or engaged in emergency work, weeks since last full-time job in private or nonemergency Government employment
Cols. 31–36. Occupation, industry, and class of worker
Cols. 37–38. Full-time weeks worked in 1939
Cols. 39–42. Wages or salary received in 1939
Col. 43. Other income of $50.00 or more? Yes or No
Col. 44. Whether on a sample (supplementary question) line or not: Sup. or No

The sample cards.—In addition, three other cards, B, C, and D, were punched for the persons whose returns fell on the sample (Suppl. Ques.) lines, covering both the supplemental questions and the regular items for these persons, which were represented by transcribed codes in columns K to Z, in the supplementary section of the schedule.[5]

Sample card B, designated the Supplementary Individual Card, involved the punching of the following items from the original entries made for the sample persons in the 2-line section at the bottom of each schedule page:

Cols. 1–10. Gang punch and sheet and line number
Cols. 11–12. Parent's birthplace
Cols. 13–14. Mother tongue
Col. 15. Veteran status
Col. 16. Social Security status
Cols. 17–22. Usual occupation and class of worker
Col. 23. Tenure of home
Col. 24. Value or rent, coded into 10 classes
Col. 25. Farm residence and sex
Col. 26. Color and nativity

Then the following items were punched from the codes which had been entered in columns K to Y, following the original entries just referred to:

Cols. 27–28. Age (column K)
Col. 29. Marital status
Cols. 30–31. Highest school grade
Col. 32. Citizenship
Col. 33. Work status
Col. 34. Time (hours worked last week *or* weeks idle)
Cols. 35–40. Occupation, industry, and class of worker
Col. 41. Weeks worked last year
Cols. 42–43. Wage or salary income
Col. 44. Other income, Yes or No
Col. 45. Relationship to head of household (coded in column Y)

Sample card C, the Fertility Card, was punched for all women 15 years old and over enumerated on the sample lines. In preparation for the first step in this process, the B cards for women of the specified age

[5] All the basic cards used in the 1940 censuses of population and housing are illustrated, with specific listing of items covered, in a mimeographed publication issued in 1940 for limited distribution.

Digitized by Google

were sorted out and arranged in sheet-and-line-number order. Then the first 20 columns on blank C cards were reproduced from the B cards, together with farm residence, which was placed in column 45. The items reproduced were as follows:

In card C columns	*From card B, columns*
1–6. Gang punch	1–6
7–8. Parent's birthplace	11–12
9. Tenure	23
10. Value or rent	24
11. Color-nativity	26
12–13. Age	27–28
14–15. Highest school grade	30–31
16. Relationship	45
17–20. Sheet and line number	7–10
45 (part). Farm residence, omitting sex	25

In the remaining columns were punched, from a special Fertility Transcription Sheet, the following items:

Col. 21. Marital status, with special detail: single; widowed; divorced: married once, husband present; married more than once, husband present; married unknown times, husband present; married, husband absent
Cols. 22–23. Age of woman at first marriage
Col. 24. Number of children ever born to woman
Col. 25. Mother tongue
Col. 26. Number of woman's children under 5 years old living in household
Col. 27. Number of woman's children 5–9 years old living in household
Cols. 28–29. State or country of birth (same as cols. 21–22 on card A)
Cols. 30–33. Migration—place of residence in 1935 (same as cols. 24–27 on card A)
Col. 34. Work status and occupation of woman, following roughly the classification used in 1930 for homemakers, as follows:
- Not in labor force
- Employed at home
- Employed away from home:
  - Professional or semiprofessional
  - Clerk, saleswoman, etc.
  - Craftsman, operative, etc.
  - Service worker, except protective
  - Other occupation
- On public emergency work
- Seeking work, with experience
- Seeking work, new worker

Cols. 35–36. Age of husband
Cols. 37–38. Highest school grade of husband
Col. 39. Work status of husband
Col. 40. Occupation group of husband
Col. 41. Weeks worked by husband
Col. 42. Wages or salary of husband
Col. 43. *Family* wages or salary
Col. 44. Other income—Yes or No
Col. 45. Color-nativity of husband

Digitized by Google

Sample card D, the Sample Family Card, was punched for each family whose head was returned on a sample line on the schedule. In preparation for the first step in this process, as with card C, the B cards representing family heads were sorted out and arranged in sheet-and-line-number order. Then the following items were reproduced, from the B cards, to blank D cards.

The items reproduced from card B were as follows:

In card D columns		*From card B columns*
1–6	Gang punch	1–6
7	Veteran status	15
8	Social Security status	16
9	Value or rent	24
10	Color-nativity	26
11–12	Age	27–28
13	Work status	33
14	Occupation (major group)	35
15–18	Sheet and line number	7–10
19 (part)	Marital status[6]	29
35 (part)	Tenure[6]	23

The remaining columns were punched from the Sample Family Transcription Sheet, which had been prepared from the population schedule, as follows:

Col. 19 (remainder). Persons 65 and over: various combinations, as no persons 65-plus; 1 male and 1 female 65-plus; 1 male and no females; etc.
Col. 20. Highest school grade completed by head: none; 1–4 grades; 5–6 grades; etc.
Cols. 21–22. Age of wife of head of household
Col. 23. Work status and occupation of wife of head (same as col. 34 of card C)
Col. 24. Number of children under 10 years old related to head
Col. 25. Number of related single children under 18 years old
Col. 26. Number of children 14–17 years old and whether in labor force: no children 14 to 17; 1 or more children 14 to 15, but none 16 to 17; etc. (9 somewhat arbitrary combinations)
Col. 27. Least duration of unemployment of related workers
Col. 28. Class-of-worker composition of related workers: various combinations
Col. 29. Weeks worked by related workers: no earners; head earner, 50 weeks or more; etc. (various groups)
Cols. 30–31. Wages or salary of first earner
Cols. 32–33. Wages or salary of second earner
Col. 34. Number of related earners
Col. 35 (remainder). Relationship of earners: no earner; head, earner, wife not; wife earner, head not; both earners; neither head nor wife earner
Col. 36. Other related person's "other" income: whether any member of family had $50 or more of nonwage income: Yes or No
Col. 37. Lodgers and subfamilies: Various combinations

[6] Remainder of column was used for other symbols.

Digitized by Google

Transcription sheet, continued:

Col. 38. Number of related persons in family
Col. 39. Number of related workers
Col. 40. Number of related workers at work or with a job during week of March 24–30
Col. 41. Number of related workers on emergency work
Col. 42. Number of related workers seeking work
Cols. 43–44. Family wage or salary income
Col. 45. Farm residence and sex (same as col. 25 on card B)

The tabulation of the 100-percent card (card A) followed in general the pattern of previous population tabulations, though in greater detail, since there were more items on the card. No important new features were represented in these tabulations, however, so one seems hardly justified in taking the space to present even brief outlines of the individual counts. The volumes in which the results of these counts are published are readily available.[7]

Practically all of the data resulting from the tabulation of the 5-percent sample, as well as various minor classifications based on the 100-percent returns, were published, not in one of the four main reports (Vols. I, II, III, and IV) of the 1940 population census, but in specially titled reports, such as Differential Fertility, Country of Origin, and Mother Tongue.[8]

THE 1940 CENSUS OF HOUSING

Partly stimulated by the value-or-rent figures from the 1930 population census, there grew up during the 1930's an increasing demand for more statistics on housing conditions. This resulted in the passage, on August 11, 1939, of an Act of Congress authorizing a census of housing, to be taken "in conjunction with, at the same time, and as part of, the population inquiry of the 16th Decennial Census." The formulation of the inquiries for such a census was greatly facilitated by the activities of an advisory committee, under the initial chairmanship of Dr. Ernest M. Fisher, one of the most effective advisory committees in the whole history of advisory committees.

The distinctive schedule finally adopted for this housing census employed a new technique, in that many of the inquiries were set up with a series of check blocks—little squares to be checked, in place of writing in words or figures, all precoded for convenience in punching. (This check-block device might be considered a forecast of the mark-sense schedule of the 1951 census of Canada—or of the schedule used in the 1960 census of population in the United States.)

[7] *Sixteenth Census of the United States, 1940*, Population, Vol. II, Characteristics of the Population; Vol. III, The Labor force; Vol. IV, Characteristics by Age.

[8] A complete list of these special reports appears in the one entitled "Fertility by Duration of Marriage," published in 1947.

Digitized by Google

The housing schedule for occupied dwellings, which is reproduced at the end of Part I of Volume II of the 1940 Census Reports on Housing, was set up in 31 columns, one of which called for identification (sheet and line number) with the population entries for the family occupying the dwelling. These numbers were punched in the housing card, so that it would have been possible to reproduce items from any family card to the housing card representing the living quarters of the family—though actually no such reproductions were made in the 1940 tabulation program.

Since the housing tabulation program represents an adaptation of earlier procedures to somewhat different material rather than a further development of the population tabulation processes, no specific details of the three housing cards, cards E, F, and G are presented—*except* for card F, designated the Household Card, which contained, in addition to 20-odd columns of strictly housing items reproduced from card E, the following "household" items, punched from a Household Transcription Sheet:

Col. 22. Sex of head of household
Col. 23. Color or race of head of household
Cols. 24–25. Age of head, by single years
Col. 26. Marital status of head, with married, spouse present and married, spouse absent
Col. 27. Citizenship of head of household
Col. 28. Migration status of head: same house as in 1935; same county but different house; outside county, rural-nonfarm; etc.
Col. 29. Work status of head of household
Col. 30. Occupation group of head of household
Cols. 31–32. Weeks worked in 1939 by head of household
Col. 33. Lodgers and subfamilies: no lodgers, no subfamilies; no lodgers, 1 subfamily, etc.
Col. 34. Total persons in household, 1 to 12-plus
Col. 35. Related persons in household, 1 to 12-plus
Col. 36. Number of related children under 21: 1 to 9-plus
Col. 37. Number of related workers: 1 to 9-plus
Col. 38. Number of related workers employed in private or nonemergency government work: 1 to 9-plus
Col. 39. Number of related workers employed on emergency work: 1 to 9-plus
Col. 40. Number of related workers seeking work: 1 to 9-plus
Col. 41. Class-of-worker composition of related workers
Cols. 42–43. Related persons' wage income; $100-intervals
Col. 44. Related persons' other income, Yes or No
Col. 45. Whether head of household was enumerated on a sample line: Yes or No

Some of this detail failed of tabulation or publication, in competition with other demands for available funds.

Digitized by Google

FURTHER CHANGES

Expansion of Professional Staff

Another radical change in the organization of the work on the census in 1940 resulted from the expansion of the professional staff of the Population Division from 2 or 3 in 1930 to 20 or 30 in 1940. This was a part of the expansion of the professional staff throughout the Bureau which followed the recommendations of the Committee on Governmental Statistics and Information Services early in the 1930's. This expansion has continued, as the program of current statistics in the Bureau has grown and as there has been a growing recognition of the need for professionally competent personnel in the Government's statistical agencies. This development reflects also the increasing degree of specialization in the Bureau's work and the growth in the number and scope of activities which are distinct from the traditional decennial or quinquennial censuses.

The Advent of the Computer

Some of the tabulations of the 1950 census of population for a few States were made on the UNIVAC, the first electronic computer designed to handle the relatively simple but voluminous processes of summation which constitute the census work heretofore handled by the punch card machinery, as this had been gradually, albeit rather slowly, improved over the period from 1890 to 1940.

For several years the laborious process of punching cards from the original returns was still required, and the material for the computer was put on magnetic tapes through a "card-to-tape" machine. The first large-scale escape from the burden of hand-punched cards was in the 1951 census of Canada, with its relatively simple mark-sense schedule, from which cards were punched by mechanical means. A mark-sense schedule was proposed for the U. S. census of 1950; but perhaps by reason of the Bureau's need for a complex and extensive schedule, this proposal was considered impracticable within the available time by the engineers who were to undertake the mechanical details.

But, before 1960, the Census Bureau and the National Bureau of Standards had developed a machine, christened FOSDIC (Film Optical Sensing Device for Input to Computers), which transferred the data from a microfilm of a properly marked schedule of position-mark pattern, direct to magnetic tape ready for the computer. The intermediate microfilm was adopted partly because the sensing from the transparent spots on the negative microfilm was a bit more reliable than the sensing of a reflected image. It proved to be a great advantage, however, to have the data for the final process in compact form, while the voluminous

Digitized by Google

original schedules were stored in some area where storage space was plentiful. In addition, the microfilm could be fed through the machine much faster than would have been possible with the original schedules, with a resulting reduction in the number of machines required.

This device did away completely with the need for punching cards[8] and speeded up more than 60-fold the process of getting the data into a form which a machine (the computer) could read.

Thus, in a few years, the electronic computer, with its supporting devices for assembling census data, had made far more progress than the punch card had made in 60 years. For the contribution of FOSDIC is in addition to the fantastic increase in operational speed of the computer and the tremendous increase in the possibilities for complex cross-classification, checking for consistency, inflation from sample, and even adjustment of variant data. It should not be forgotten, however, that a part of the price for all these advantages is the cost of maintaining a large staff of professional programmers, to set up the complicated specifications which are required for even the simplest tabulations.

With this brief notation of recent progress, the present story comes to an end. But one might hope that, presently, some adventurous writer, perhaps a nontechnical man who has acquired an understanding of these recent developments, so to speak, from the outside, as E. Dana Durand had done with the machinery of 1910, might set down a record of the developments between 1950 and 1960 and later, in nontechnical terms (or in terms as little technical as possible) so as to bring the record up to date.

[8] Strictly, FOSDIC did not really eliminate the "hand" (and head) work that had gone into punching cards, but transferred most of it to the enumerator in the field, who, in place of writing the answers to his questions in familiar characters, sought out the designated spots on the printed schedule for the required position-mark strokes.

Digitized by Google

APPENDIXES

Digitized by Google

Appendix A.—MR. PORTER'S LONDON PAPER

Excerpt from a paper read by Robert P. Porter, Superintendent of the Eleventh (1890) Census, before the Royal Statistical Society, in London, December 4, 1894.

The tabulated results of the Tenth Census (1880) were all obtained by hand-tallies, a mechanical device being used simply for holding the tally-sheet in place and as a guide to the eye in finding the proper place for making the entry thereon. In the Eleventh Census (1890), however, the Hollerith Electric Tabulating system was adopted, by means of which the information concerning each individual was transferred by punching to a separate card, and the several tabulations necessary to comprehend the information punched thereon obtained by the use of electrical machines, on which the cards were successively sorted and counted.

The methods of tabulation used in 1880 and 1890 can be readily contrasted for such subjects of tabulation as were common to both censuses, so as to show very clearly the greater detail obtained in 1890 as compared with 1880, as well as to illustrate in a graphic manner the increased complexity of results obtained by a single handling of the cards through the use of the electrical machines as compared with the comparatively simple results obtained by the use of hand-tally methods.

Population Distributed according to Dwellings and Families.

Eleventh Census (1890)	Tenth Census (1880).
The first count of the returns in 1890 gave, in addition to the aggregate population for each civil division separately enumerated, the total number of dwellings and families, the number of persons to a dwelling and to a family in detail, as 1, 2, 3, or 4 persons, to the highest number reported, the average number of persons to a dwelling and to a family, besides a special classification of the number of families to a dwelling; this information regarding dwellings and families being of the highest importance in determining relative conditions of the people living in urban and rural districts, particularly as regards the great cities where the population is very much congested.	The aggregate population in 1880 was ascertained by counting in duplicate the number of entries on the population schedules for each given district. As regards dwellings and families a simple count was made as to the total number of dwellings and families in each district, and the average number of persons to a dwelling and to a family in each case.

Digitized by Google

Population classified by Sex, General Nativity, Colour, and Age Groups.

Eleventh Census (1890).	Tenth Census (1880).
By a single handling of the punched cards there were obtained in 1890 a primary division of the population according to native white of native parentage, native white of foreign parentage, foreign white, native coloured, and foreign coloured, subdivided according to sex and by certain age periods. For all adult males of foreign birth a further classification was obtained as regards the number who had been naturalised, who had taken out naturalisation papers, or who were aliens, aliens being also classified as to whether they could speak the English language or not. In the same way, the native and foreign coloured were subdivided as to the number of blacks, mulattoes, quadroons, octoroons, Chinese, Japanese, and civilised Indians. For all householders, also, a separate classification was made as to the number who hired or owned their farms, and if owned, the number of homes or farms that were free or mortgaged. The results of this count comprehended, therefore, not only the simple statements as to the number of males and females, the number of native born and foreign born, the number of whites, negroes of pure or mixed blood, Chinese, Japanese, and civilised Indians, but the various combinations of facts relating to sex, colour, and general nativity for each of the primary divisions of the population as regards age, including children less than 1 year of age and children under 5 years of age, of special importance for purposes of vital statistics; the number of children between 5 and 20 years of age, or the ages covering most school attendants; the number of males between the ages of 18 and 44 years, or the militia ages; the number of males 21 years of age and upwards, representing the potential voting ages, and the number of persons 45 years of age and upwards.	In 1880 the population was tallied according to white and coloured, subdivided as to sex and whether native or foreign born, the number of Chinese, Japanese, and civilised Indians being separately noted where such occurred. The classification of the population in 1880 according to school, militia, and voting ages was derived from a separate count according to ages in detail, referred to later on. No information was obtained in 1880 regarding either the citizenship of foreign born males of voting age or the ownership of homes and farms.

Digitized by Google

Population classified according to Conjugal Condition.

Eleventh Census (1890).	Tenth Census (1880).
The tabulation in 1890 of the number of single, married, widowed, and divorced comprehended for each of the five divisions of the population already referred to, a subdivision according to sex, 10 age periods, and 14 birthplaces of mothers. The subdivision into age periods comprehended persons less than 15 years, 15 to 19 years, 20 to 24 years, 25 to 29 years, 30 to 34 years, 35 to 44 years, 45 to 54 years, 55 to 64 years, 65 years and upwards, and age unknown, while the birthplaces of mothers were specified for the following named countries: Ireland, Germany, England and Wales, Canada and Newfoundland, Sweden, Norway, and Denmark, Scotland, Bohemia, France, Hungary, Italy, Russia, other countries, United States, unknown.	Information obtained in 1880, but not compiled.

Population distributed according to Place of Birth.

The native born population in 1890 was distributed, without regard to sex, according to the State or territory where born, or more than 50 places of birth in all, for each of the three elements into which it was subdivided, viz., native white of native parentage, native white of foreign parentage, and native coloured, a further subdivision according to sex and quinquennial age periods being made for those born and living in the State where enumerated. The foreign born population in 1890 was distributed, without regard to sex, according to country where born, or 42 places of birth in all, for each of its elements, viz., foreign white and foreign coloured. The alien element of the population—that is, foreign born adult males who had not become naturalised—were also separately counted according to country of birth in detail, and, in addition, according to the number of years they had been in the United States.	The birthplace of persons residing in the United States in 1880 was tallied for the native white and native coloured according to State or territory of birth, or about 50 in all; and for the foreign born, in practically the same detail regarding country of birth as in 1890. As already stated, no information was obtained in 1880 as to the citizenship of foreign born males of voting age.

Digitized by Google

Population Classified by Ages (in detail), Parentage, Illiteracy and School Attendance, Ability to Speak English, &c.

Eleventh Census (1890).	Tenth Census (1880).
By the next tabulation of the punched cards there were obtained in 1890 for each of the primary divisions of the population, first, a classification by sex according to single years of age from one year to the highest age reported, and for those less than one year of age by periods of months; second, a classification, without regard to sex, according to native or foreign parentage, specifying for persons of foreign parentage the number having either one or both parents born in Ireland, Germany, England, Scotland, Wales, Canada (English), Canada (French), Sweden, Norway, Denmark, Bohemia, France, Hungary, Italy, Russia, and other countries; third, a further classification of the birthplaces of mothers according to quinquennial age periods, for vital statistics purposes; fourth, a classification by sex and quinquennial age periods for all persons 10 years of age and upwards, according to whether they were able to read and write, and whether they were able to speak English or not, and for all persons of school age according to months of school attendance; fifth, a classification of the surviving veterans of the civil war, both United States and Confederate, and the widows of such as have died, according to quinquennial age periods.	In 1880 similar information was obtained by separate tallies, as follows: First, ages were tabulated by sex for the native white, foreign white, and coloured, according to single years of age, and from this tally were obtained the various presentations regarding age, race, and sex; second, foreign percentage was tallied for a little more than one-half of the total population in 1880, according to whether the person was native or foreign born, and whether one or both parents were of either of the following nationality groups; United States, Ireland, Germany, Great Britain, Scandinavia, British America, and other countries, the ratios derived therefrom being applied to the total population of the United States to obtain similar results for the whole country; third, the number of illiterate persons 10 years of age and upwards, were tallied for the native white, foreign white, and coloured, according to sex, and for the total white and coloured according to three age periods, viz., 10—14 years, 15—20 years, and 21 years and upwards, while the number of pupils attending school during the census year was tallied according to sex, and whether white or coloured. No information was obtained in 1880 as to language spoken or concerning surviving veterans of the late war.

Population Classified according to Occupations.

The occupations of the people, as returned by the census enumerators in 1890, have been tabulated in the main in accordance with the classification used in 1880, modified to a certain extent to meet the requirements of the present census. The tabulated results in 1890 show the number of persons engaged in each remunerative occupation, subdivided by sex and whether	In 1880 each specified occupation was tallied according to sex and three age periods, namely, 10 to 15 years, 16 to 59 years, and 60 years and upwards. For the foreign born, also, a separate statement was made regarding nationality, as follows: Ireland, Germany, Great Britain, Scandinavia, British America, and other countries. No separation regarding occupations in

Digitized by Google

Population Classified according to Occupations—Contd.

ELEVENTH CENSUS (1890).	TENTH CENSUS (1880).
native white of native parents, native white of foreign parents, foreign white, or coloured, persons of negro descent being separately distinguished from all other coloured, that is, Chinese, Japanese, and civilized Indians. Regarding each of these elements a further subdivision has been made for each given occupation according to conjugal condition, months unemployed during census year, ability to read and write, ability to speak English, ownership of homes and farms, and whether veterans of the late war, United States or Confederate, or widows of such as have died, and also for ten age groups, as follows: 10 to 14 years, 15 to 19 years, 20 to 24 years, 25 to 34 years, 35 to 44 years, 45 to 54 years, 55 to 59 years, 60 to 64 years, 65 years and upwards, and unknown. In addition, a separate classification according to fourteen birthplaces of mothers has been made for the native white of foreign parents and the foreign white, besides a further subdivision of the foreign born population according to fourteen principal countries of birth, and for foreign born males of voting age a still further subdivision according to citizenship, that is, whether naturalized or not, the alien element being also classified according to length of residence in the United States.	1880 was made as to colour and general nativity, number of months unemployed, illiteracy, or conjugal condition, although this information was returned on the population schedule at that census.

Upon the completion of the occupation count in 1890, the punched cards have been so sorted as to readily furnish, if desired, much additional and highly complicated data regarding the illiterate, non-English speaking elements of the population, subdivided as to sex, age, nationality, occupation, and citizenship, besides furnishing the basis of a most complete presentation regarding the relative fecundity of women of different nationalities, the necessary data having been obtained in 1890 for the first time in a United States Census, but for both of which the tabulations could not be completed under the present temporary organization of the Census Office.

Digitized by Google

Appendix B.—CONTEMPORARY PORTRAITS OF MEMBERS OF THE CENSUS OFFICE STAFF IN 1890, WITH BRIEF COMMENT

(Mainly from *Frank Leslie's Illustrated Newspaper* of October 12, 1889)

The article on which this appendix is based consists mainly of a summary of the plans for the Tenth Census, including a brief discussion of some of the expected problems. It begins with the words "The omnipresent statist will soon be abroad in the land." Note this use of the word "statist" in an article written for the most part in strictly journalistic style. The pictures and the brief paragraphs of comment are by way of supplement—the comment perhaps chiefly to justify the use of the illustrations.



ROBERT P. PORTER

Robert P. Porter, Superintendent of the Census from 1889 to 1893, was employed on the 1880 censuses as expert in charge of the reports on Valuation, Taxation, and Public Indebtedness. He served later on the Tariff Commission and then on the editorial staff of the *New York Tribune* and the *Philadelphia Press*. He thus came into the position of Census Superintendent with a wide range of experience. (See excerpt from a paper which he read before the Royal Statistical Society, in London, in Appendix A.)



HENRY GANNETT

Henry Gannett, the Geographer of the Census, had held this position in the 1880 Census—and continued in it through the 1900 census period. Mr. Gannett is a gentleman of national reputation as a scientist and has published a number of valuable reports for the Government. Not the least of his contributions is a series of maps showing the progress of settlement, decade by decade, in the territory which is now the United States. These appeared first in the 1880 Report on Population and have been reprinted, with additions, in later reports.

Digitized by Google



JAMES H. WARDLE

James H. Wardle is acting Chief Clerk. (He later became Chief Clerk.) He began his carrier in census work in the New York State Census Bureau in 1875 and was Chief of the Agricultural Division of the United States Census of 1880. He also had charge of all matters relating to the Tenth Census (1880) from the termination of that work until the organization of the 1890 Census staff.



JOHN S. BILLINGS

Dr. John S Billings, Surgeon, U.S. Army, is in charge of vital statistics and special classes. Dr. Billings, even in 1889, was widely known throughout the civilized world for his scientific attainments, and honored by institutions of learning at home and abroad. (See further details and a later portrait in chapter II.)



WILLIAM C. HUNT

William C. Hunt, the Statistician in charge of the Population Division, is a man well trained in the Massachusetts Bureau of Statistics of Labor, who made a reputation in the tabulation of the Massachusetts State Census for 1885. (He continued in charge of the U.S. census work on population until 1925.)



FRANK R. WILLIAMS

Frank R. Williams, Chief of the Division of Manufactures, had charge of the Division of Manufactures under Gen. Francis A. Walker in 1880. His experience will enable him to avoid many of the difficulties which may be encountered in the work of 1890.

Digitized by Google



DAVID T. DAY

David T. Day is Chief of the Division of Mines and Mining. Dr. Day is currently Chief of the Division of Mining Statistics and Technology of the U.S. Geological Survey and has prepared for a number of years the annual volume of that office on "The Mineral Resources of the United States."



HERMAN HOLLERITH

Herman Hollerith is president of the Tabulating Machine Co., which is providing, on a rental basis, the punch card machines for the tabulation of census data on population and vital statistics. For further details with regard to Mr. Hollerith (and a later portrait) see chapter II.



HENRY C. ADAMS

Prof. Henry C. Adams, Statistician for the Interstate Commerce Commission, is Chief of the Division of Transportation. Professor Adams has attracted considerable attention by his excellent report on the railways of the country. He is a student of political economy and lectures on this subject at the Universities of Michigan, Cornell, and Johns Hopkins. He is first vice president of the American Economic Association and has contributed much to the literature on economics and finance.

Digitized by Google

Appendix C.—"DIRECTORS" OF THE CENSUS, 1790–1964

For the first five censuses, from 1790 to 1830, the census was conducted under the general supervison of the Secretary of State; in 1840, there was a Superintending Clerk; from 1850 to 1890 the census was directed by a Superintendent; and from 1900 the man in charge of the census and of the related activities of the permanent Census Bureau, established in 1902, was designated Director of the Census. Following is a list of the specific officials occupying these various positions, from 1790 to date:

First Census, 1790: Thomas Jefferson, Secretary of State
Second Census, 1800: John Marshall, Secretary of State
Third Census, 1810: Robert Smith, Secretary of State
Fourth Census, 1820: John Quincy Adams, Secretary of State
Fifth Census, 1830: Martin Van Buren, Secretary of State
Sixth Census, 1840: William A. Weaver, Superintending Clerk
Seventh Census, 1850: Joseph C. G. Kennedy, Superintendent, 1850–1853; J. D. B. DeBow, Superintendent, 1853–1854
Eighth Census, 1860: Joseph C. G. Kennedy, Superintendent, 1860–1865
Ninth Census, 1870: Francis A. Walker, Superintendent, 1870–1873
Tenth Census, 1880: Francis A. Walker, Superintendent, 1879–1881; Charles W. Seaton, Superintendent, 1881–1885
Eleventh Census, 1890: Robert P. Porter, Superintendent, 1889–1893; Carroll D. Wright, Commissioner of Labor, in charge, 1893–1897
Twelfth Census, 1900: William R. Merriam, Director, 1899–1903

The remaining censuses were conducted by the permanent Bureau of the Census, established during the term of Mr. Merriam. Later officials in charge were as follows:

S. N. D. North, Director, 1903–1909
Thirteenth Census, 1910: E. Dana Durand, Director, 1909–1913; William J. Harris, Director, 1913–1915
Fourteenth Census, 1920: Sam L. Rogers, Director, 1915–1921
Fifteenth Census, 1930: William M. Steuart, Director, 1921–1933
Sixteenth Census, 1940: William L. Austin, Director, 1933–1941; J. C. Capt, Director, 1941–1949
Seventeenth Census, 1950: Roy V. Peel, Director, 1950–1953
Eighteenth Census, 1960: Robert W. Burgess, Director, 1953–1961; Richard M. Scammon, Director, 1961–1965; A. Ross Eckler, Director, 1965–.

U.S. GOVERNMENT PRINTING OFFICE: 1965 O - 758-612

Digitized by Google

